AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 81 Number 11

CONTENTS

C. A. MUSSELMAN, Pres.; J. S. HILDRETH, Vice-Pres. and Manager, Automotive Division; G. C. BUZBY, Vice-Pres.

OFFICES

Philadelphia—Chestnut & 56th Sts., Phone Sherwood 1424
New York—239 W. 39th St., Phone Pennsylvania 6-1100. Chicago—Room 916, London Guarantee & Accident Bldg., Phone Franklin 4243. Detroit—1015 Stephenson Bldg., Phone Madison 2090. Cleveland—609 Guardian Bldg., Phone Cherry 4188. Washington—1061 National Press Bldg., Phone District 6877. San Francisco—444 Market St., Room 305, Phone Garfield 6788. Los Angeles—6000 Miramonte Blvd., Phone Lafayette 5525. Long Beach, Cal.—1595 Pacific Ave., Phone Long Beach 613-238.
Cable Address .....Autoland, Philadelph'a

Member of the Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Automotive Industries—The Automobile is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903, the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by

CHILTON COMPANY
(Incorporated)
Executive Offices
Chestnut and 56th Streets, Philadelphia, Pa., U. S. A.

AUTOMOTIVE INDUSTRIES, Vol. 81, No. 11. Published semi-monthly by Chilton Co. Chestnut & 56th Sts., Phila. Entered as Second-Class Matter October 1, 1925, at the Post Office at Philadelphia, Pa.; Under the Act of Congress of March 3, 1879. In Case of Non-Delivery Return Postage Guaranteed. Subscription price: United States, Mexico, United States Possessions, and all Latin-American countries, $1.00 per year. Canadian and Foreign, $2.00 per year; single copies, 25 cents, except Statistical Issue (Feb. 25, 1939), 50 cents.

HAVE YOU EVER CONSIDERED *Why* A VICTOR OIL SEAL IS LIKE A FINE WATCH?

The answer tells why "VICTOR SEALS OF SECURITY" *pace the industry today*

A watch is able to render dependable, faultless service with split-second accuracy only because each and every part is a precision job of the highest order.

A Victor Oil Seal is a precision job, too. Its parts are not so numerous or so small as watch parts. Tolerances are not so fine. But the service it renders is just as vital *in its place,* as is the correct time to a railroad engineer or a laboratory expert. And among products of its kind it is made with a *precision* that is outstanding.

Victor engineers and craftsmen know that Victor "Seals of Security" perform a service that is *vital.* Failure of such seals would render valuable machinery useless. That is why Victor "Seals of Security" are designed and built to give better sealing service—a better assurance against failure—a longer life.

Victor's accepted position as a *leader* in its industry is due to the high standards of precision craftsmanship maintained in the modern Victor plant. Also to the development of better merchandising, packaging, labeling and cataloging methods. We will gladly discuss any sealing problem with you. Victor Manufacturing & Gasket Co., P. O. Box 1333 . . . 5750 Roosevelt Road, Chicago, Illinois, U. S. A.

VICTOR

GASKETS • OIL SEALS • GREASE RETAINERS

SEALS OF SECURITY

The Victor Buyer's Guide

Rated by users everywhere as an outstanding achievement in cataloging for the Gasket industry. It makes ordering easy and accurate. A great time- and error-saver.

AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 81, No. 11
December 1, 1939

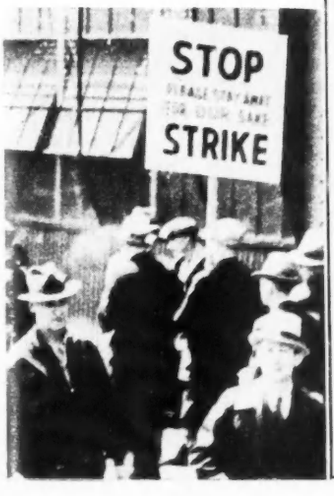
They Pay Their Money But They Have No Choice

By JULIAN CHASE

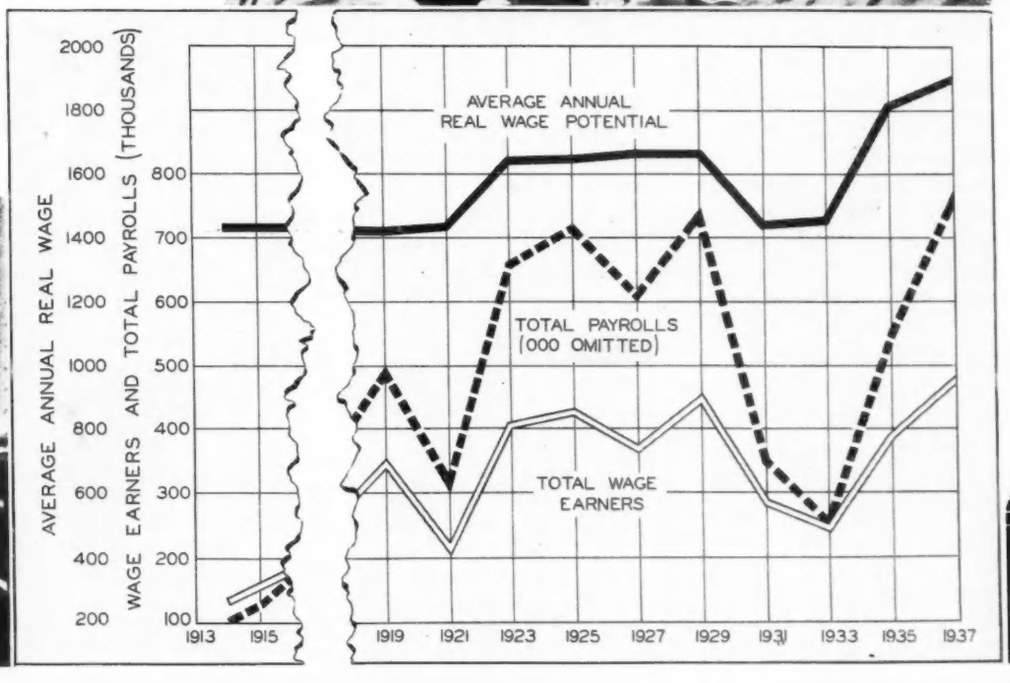
WHEN he signed the National Labor Relations Act on July 5, 1935, President Roosevelt issued a statement in which he said, "This act defines, as a part of our substantive law, the right of *self-organization* of employes in industry for the purpose of collective bargaining and *provides methods by which the Government can safeguard that legal right.* * * * By preventing practices which tend to destroy the independence of labor, it seeks, for *every worker* within its scope, *that freedom of choice which is justly his.* * * * It does not cover all industry and labor, but is applicable only when violation of the legal right of *independent self-organization* would burden or obstruct interstate commerce."

The italics in these quotations from the President's excellent expression of a most worthy purpose are, of course, ours. He believed, no doubt with complete confidence, that these priceless objectives would be attained by the means which the law provided. It has always been the hope of nearly all of us, except those who pad their purses with the proceeds from labor strife, that these high aspirations might some day, some how be realized.

But many of us thought, and still do, that directly



The chart, based on Government data, shows how automobile, body and parts makers have increasingly contributed through employment and wage payments to national purchasing power.



GENERAL

opposite ends would be reached and that no other than opposing ends could be reached as the results of developments that would naturally and logically follow the adoption of the law. The four years since the law was passed have given us disturbing evidence of the correctness of that belief. Not only accomplished facts but obvious trends, progressing under the law's artificial stimulation, give strength to the conviction that the Wagner Law, which clearly has not done it yet, can not do what its advocates and endorsers said it would do. In certain vitally important respects, it seems, the accomplishments of the law are the antitheses of its idealistic purposes.

What, for example, has been happening during the past four years to the workers "right of self-organization?" We were assured that the law "provides methods by which Government can safeguard that legal right." We have seen, instead of governmental protection of that right, governmental inaction during its deflation. We have seen, in the automotive industry and in industry generally, large groups of workers denied that right by labor agitators unopposed, to say the least, by Government. We have seen these workers driven into organization not by spontaneous action but by external compulsion. We have seen them attach themselves to artificially inseminated nucleuses, not as acts of their own free choice but as tragic measures of expediency.

We have seen, since the signing of the Wagner Law, a marked quickening in the growth of forced organization. The worker's right of free choice is rapidly becoming only a withered memory. The broad privilege of joining or *not* joining has been reduced, through the narrowed choice of joining this or joining that, to the beggar's choice of joining this or not eating. "That freedom of choice which is justly his," in industries covered by the law, is largely, today, only something for the worker to read about in the Bill of Rights and in Presidential statements.

We are living today in a period that is radically reactionary. If we continue to go as we are now headed, we shall soon be back to days and conditions that we thought were deeply buried under several centuries of progressive history. Who, today, is championing the rights of the individual? Who is safeguarding the worker's right to *independent* self-organization? Who is protecting him in the supposedly inalienable right to freedom of choice in joining or *not* joining? Who is upholding his right to work without paying tribute? Certainly not the Government!

America was built on the hope for freedom. It grew on acknowledged and protected liberty for the individual. It flourished on the exercise of individual initiative and the creation of individual opportunity. It will decline if we permit ourselves to return to institutionalism.

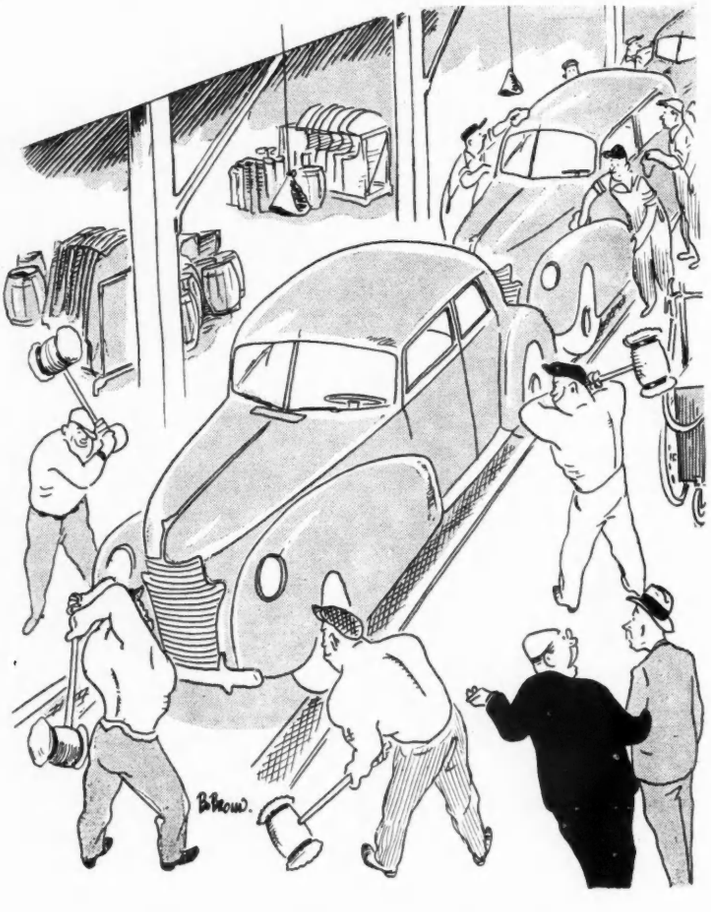
Our automotive industry, one of the most prolific job and wage providers in the world's economy, is the product of the American System of Enterprise. Nowhere else in the world and under no other conditions could it have reached its vast capacity to contribute to national purchasing power. During the past 20 years it has given employment, in the automobile manufacturing plants alone, to an average of nearly 400,000 workers. It has paid out an annual average of 5.5 billion dollars in wages. It has, in 20 years, paid out to workers over 100 billion dollars, an accumulated amount more than twice the size of our national debt as it now stands in this the seventh year of the New Deal.

Since the days of its beginning, the automotive industry has been outstandingly liberal in its treatment of labor. Attracted by high wages and good working conditions, great masses of potential workers were steadily drawn to centers of automotive manufacturing where, according to surveys, including those made by the Department of Labor, the highest living standards prevailed. For nearly 40 years, until the appearance of institutionalism, first manifested in the shape of N.R.A., the industry was conspicuously free from labor trouble. There were almost no interruptions of production due to strikes or other labor difficulties.

But now, as is only too well-known, the

(*Turn to page* 608)

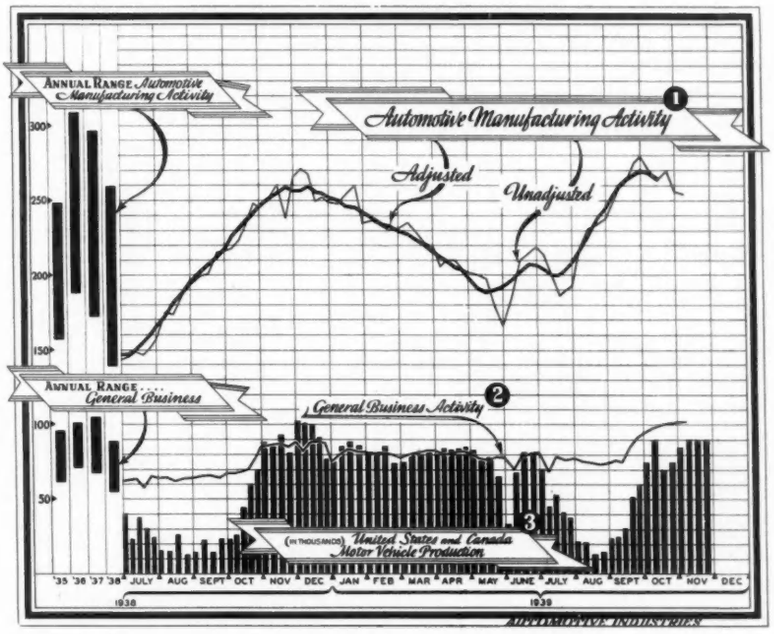
The Brass-Hat Rack



"We find it's more economical to junk them before they get to the public!"

BUSINESS IN BRIEF

Our own view of automotive production and sales; authoritative interpretation of general conditions



Weekly indexes of automotive general business charted

Quarter Pushing Million Units

PRODUCTION of cars and trucks in November failed to show a significant increase over October principally because of labor difficulties which have continued to plague the industry since the beginning of the 1940 season.

With an unusually strong retail demand being shown in all sections of the country and with dealers beginning the new model season in excellent condition from the standpoint of stocks of both new and used vehicles, all factors except labor peace were present to have permitted November production to break into new high ground for this period of the year and to have made the final quarter of 1939 one of the best last quarters in recent years.

Total November production of cars and trucks is estimated at approximately 375,000 units, although this estimate is necessarily tentative because it was made while the prolonged Chrysler strike was still in effect. Settlement of the strike and resumption of operations in all Chrysler divisions would result in a sharp upward revision of this total for November, which as it stands represents a drop of approximately 15,000 cars and trucks from the November, 1938, total.

By the middle of November the industry was moving along at a rate fairly close to 90,000 cars and trucks weekly and was expected to continue this pace for the balance of the month with any production by the Chrysler divisions to be considered an additional increment. All other producers were operating at rates which they deemed as close to capacity as current demand indicated.

Sales reports continued to be highly optimistic during November with practically all manufacturers showing healthy gains over the same period a year ago and with a number of major manufacturers reporting growing banks of unfilled domestic retail orders. Used car turnover was also reported to be highly satisfactory with sales well in excess of last year although stocks were increasing because of trades involved in the increased number of new car sales.

Estimated November production of at least 375,000 cars and trucks combined with the Automobile Manufacturers Association estimate of October factory sales totaling more than 337,000 cars and trucks indicates total production for the first two months of the last quarter of the year well above 700,000 units and also indicates that total production for the last quarter should be well in excess of a million units barring further labor difficulties. Final figures for the quarter, however, will be nowhere near what they would have been were it not for the prolonged Chrysler strike which, as this was written, was well into its sixth week and had become the longest continuous labor dispute in the industry's history, exceeding in length the 1937 General Motors strike.

AUTOMOTIVE MANUFACTURING ACTIVITY sought lower levels during the weeks ended Nov. 4 and Nov. 11, bringing the unadjusted index curve charted above through the points 256 and 254. The adjusted index also turned downward and for the weeks ended Oct. 14 and Oct. 21 moved to 269 and 265, respectively.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp., New York. 1926 = 100; [3] Estimated by J. A. Laansma, Detroit News Editor, AUTOMOTIVE INDUSTRIES.

BUSINESS ACTIVITY

By H. E. BLANK, JR.

PRECISION that would excite the respect and envy of the finest Swiss watchmakers is commonplace in the production of Diesel fuel injection pumps. Manufacturing tolerances specified for some parts in these mechanisms that must withstand severe and widely varying service conditions are as incredibly low as thirty-nine millionths of an inch. The combination of such accuracy with volume output, even in an age of indifference to industrial miracles, deserves classification as a production phenomenon.

A pioneer manufacturer of this equipment in the United States is the American Bosch Corp. Two basic types of pump are built at the company's plant at Springfield, Mass. One type has a self-contained drive, the other is designed for external drive. The former is manufactured in three different sizes and, while the bulk of production is on four- to six-cylinder types, there are facilities for manufacturing from one- to 12-cylinder units. The self-contained type is installed mainly on small bore and stroke highspeed engines for automotive and tractor service. Most of the external drive pumps are single-cylinder units. This type, of which six different sizes are produced, is used principally on medium and large bore and stroke engines for marine, industrial, and other purposes. All American Bosch fuel injection pumps are of the constant-stroke, cam-actuated, lapped-plunger design.

Drilling spray holes in multiple-hole spray nozzles. The holes are as small as 0.006 in. in diameter and are drilled at various locations and angles in alloy steel. Note the magnifying glass used by the operator to observe the work.

This description of manufacturing methods employed by American Bosch is limited to multi-cylinder injection pumps with self-contained drive. Inasmuch as there are many parts in a pump of this type, only the major components and sub-assemblies can be considered here. Factory routing schedules shown herewith provide detailed data on operations and machines for several parts. These data are augmented by illustrations which show several new machines on the production lines, recently installed heat-treating equipment, views of assembly operations, and close-ups of some of the unique equipment especially designed for high-precision work.

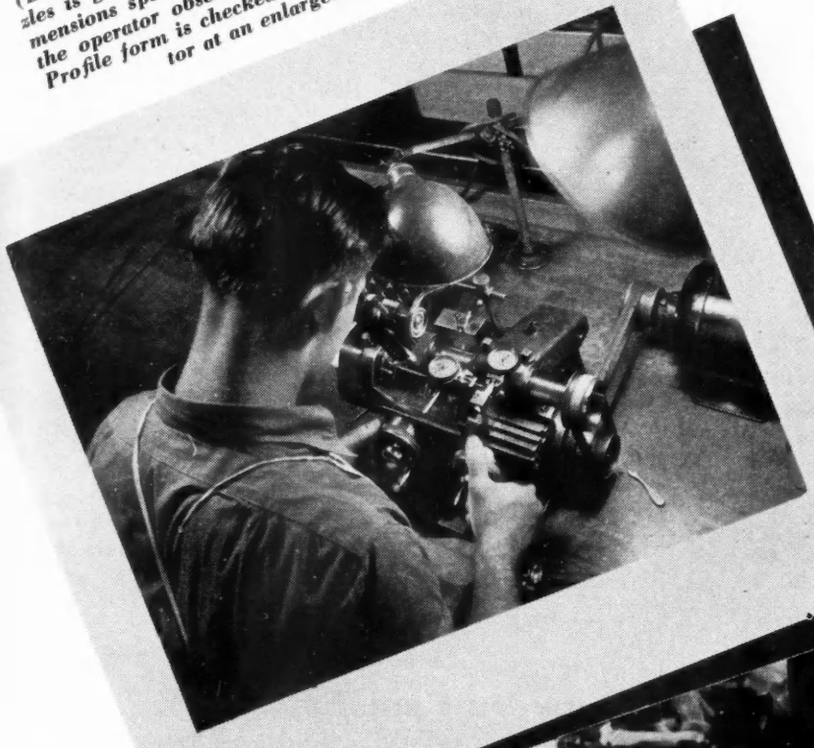
The housing for the self-contained drive type of pump is an aluminum alloy casting which requires intricate coring. Rigid specifications state that the

This is the Forty-third in the series of monthly production features

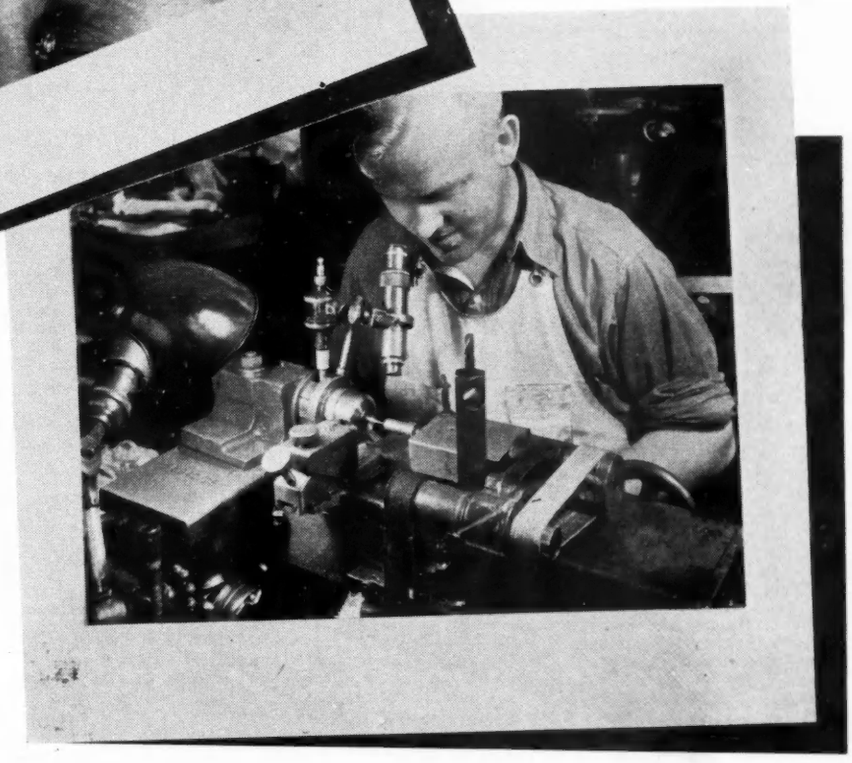
Tolerances at the Vanishing Point

On the production line of American Bosch injection pumps, manufacturing precision strikes a high degree of accuracy

(Below) The spray profile on valves for pintle type nozzles is ground on this specially designed machine. Dimensions specified for this operation are so small that the operator observes the work through a microscope. Profile form is checked on a Jones & Lamson comparator at an enlargement of 50 to 1.

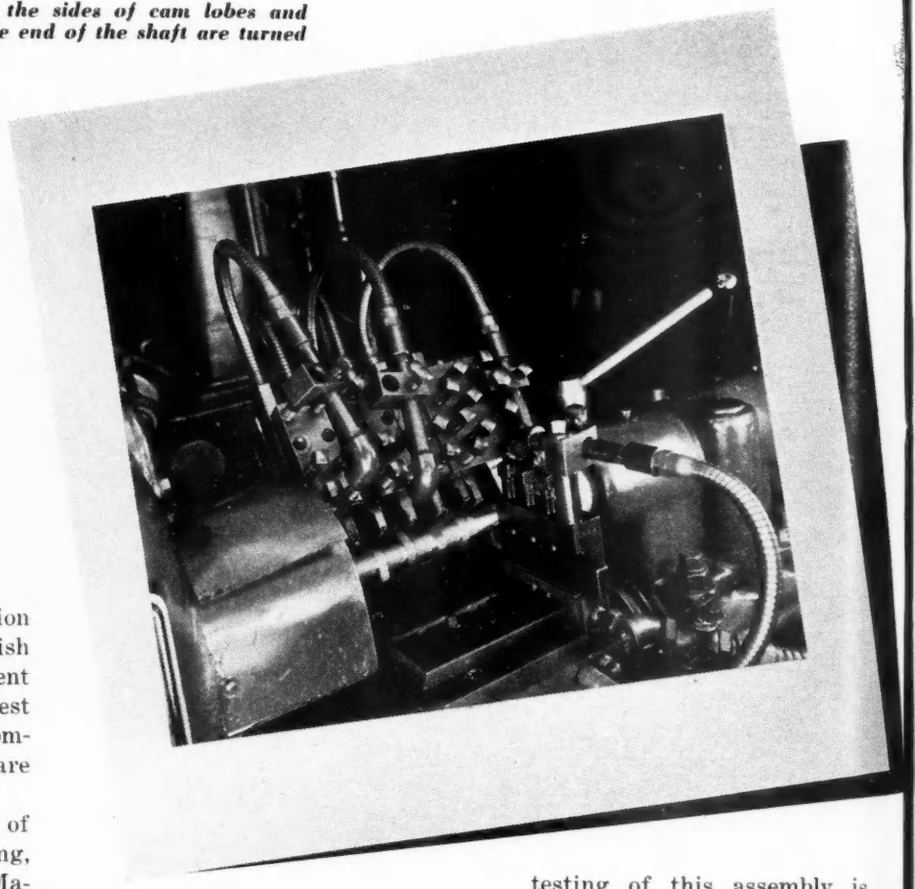


(Below) The spray hole in pintle type nozzle body is ground on another specially designed bench grinder. This operation also requires great skill inasmuch as spray holes are frequently as small as one millimeter in diameter and limits are very close.



housing must be free of pores, dust proof, and hydraulic pressure tight at 500 lb. per sq. in. In machining, a variety of fixtures are required to accommodate the multi-cylinder housings, which may be either flange or base-mounted types. Great care is taken to clean the housing, and all other pump components, after each finish machining operation. This is accomplished by the use of compressed air and various dipping processes. Virtually every

Fay automatic lathe set up for turning the sides of cam lobes and shaft ends. One side of each lobe and one end of the shaft are turned at one time.



machining operation performed not only on the housing, but on all other parts is followed by meticulous checking of the work with precision gages.

The camshaft is a drop forging made of low carbon steel. It is received at the factory in an annealed state (130 Brinell), and must be free of seams, pipes and flaws. Briefly, the operations on the camshaft consist of turning of shaft and cam lobes, and rough grinding cam lobes. The camshaft is then hardened to 60 min. Rockwell C 150 and a 100 per cent hardness inspection is made. A straightening operation follows, and lobes and tapers are finish ground. Finally there is a 100 per cent inspection involving both a visual test and the use of a Pratt & Whitney Comparator in which the lobe profiles are compared with a master cam.

The roller tappet assembly consists of the shell, roller pin, floating bushing, roller, adjusting screw and locknut. Materials from which these parts are made are as follows: shell—low carbon steel, drop forging; tappet pin—chromium-nickel steel, roller bushing and roller—chromium steel, adjusting screw and locknut—low carbon steel. Specifications call for a floating fit of the tappet pin with the shell. The shell itself has a gliding fit into the closely machined recesses of the aluminum housing. Very close running fits are specified between roller pin, floating bushing and roller. Highly important in the inspection and testing of this assembly is the investigation for squareness of the pin with the tappet shell; likewise, the testing for squareness and concentricity of the adjusting screw with the tappet shell. The pin, floating bushing and roller are hardened to 59 min. Rockwell C 150. Four components—pin, bushing, roller and shell—are highly ground parts.

Plungers and barrels are made from round stock (chromium steel) which is purchased to very strict specifications and is checked at the plant by careful

Manufacturing Operations On Camshaft

	OPERATION	EQUIPMENT
1	Straddle mill ends (2 shafts at a time)	Cincinnati miller
2	Center both ends	2-spindle drill press
3	Rough turn 1 end	12 in. engine lathe
4	Finish turn sides of lobes and ends of shaft—Rough mill keyway in both ends. (2 machine set-up)	8 by 21 in. Fay automatic lathe Whitney hand miller
5	Slot one end	Bench miller
6	Thread both ends	No. 2 Warner and Swasey turret lathe
7	Stamp 1 end and lobe	Screw press
8	Rough turn cam lobes	Walcott lathe
9	Rough grind cam lobes	Norton cam grinder
10	Inspect	
11	Carburize as per specifications	Leeds and Northrup Homocarb furnace
12	Harden as per specifications	Leeds and Northrup Vapocarb furnace
13	Temper at 300 deg. Fahr. for one hour	Leeds and Northrup Homo tempering furnace
14	Inspect	
15	Straighten	Screw press
16	Clean centers	2-spindle drill press
17	Finish mill 2 keyways Tolerance for width of keyway: 0.018 mm. or 0.0007 in. on 2 machines ±10 mm.	Bench miller
18	Semi-finish grind profile on 2 machines	Norton cam grinder
19	Finish grind profile on 2 machines Tolerance for base circle of profile: 0.04 mm. or 0.0015 in. Angular relation of lobes: ±10 min.	Norton cam grinder
20	Finish grind bearing seat diameter and taper on both ends Tolerance for bearing seat diameter: 0.009 mm. or 0.00035 in.	Cincinnati grinder
21	Stamp 2 timing marks	Bench
22	Stone and polish 2 timing marks	Bench
23	Stone 2 shoulder edges, wipe with oil	Engine lathe
24	Inspect	

study of microphotographs and chemical analysis. The preliminary operations involve turning, drilling, milling, reaming, and hardening to 61 min. Rockwell C 150. Both plungers and barrels are then ground and lapped. Subsequent inspection calls for a 100 per cent hardness test and a 100 per cent test for straightness of the bore by means of pneumatic micrometers. The bore of the barrel is also checked with pneumatic micrometers. Finally, each plunger and barrel assembly is checked for fit along the helix portion and the stem portion by hydraulic test. In this test, high pressure is built up and the pressure drop is observed over a range of 8500 lb. per sq. in. to 7500 lb. per sq. in. within a specified minimum and maximum time interval.

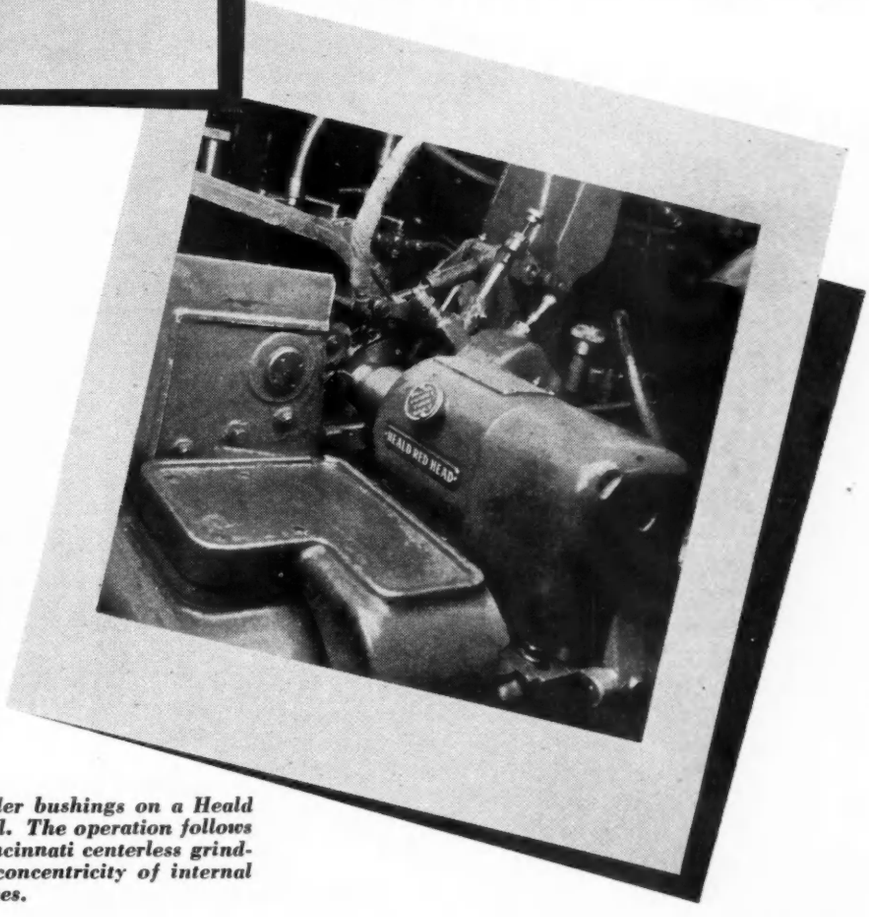
Delivery valves are of alloy steel round stock. The valve body is chromium steel, and the valve stem, chromium-nickel steel. After a number of turning, drilling, reaming, milling, threading and hardening operations are completed, a 100 per cent hardness inspection is made. Rough and finish grinding and lapping operations follow. Selective assembly is followed by 100 per cent inspection for fit by gages and Hirth Minimeters. There is a hydraulic leakage test for tightness through the valve seat, and another hydraulic test checks the retraction action or pressure relief action of the displacer piston on the valve stem.

Plunger and delivery valve springs are made of a high grade chromium-vanadium alloy spring steel. The first of a number of exacting tests to which these springs are subjected is a 100 per cent load test. Flaws and surface defects are detected by a magnaflux test. An endurance test compresses these springs more than 5,000,000 times under conditions that are more severe than those encountered in actual service. Plunger springs are doubly lacquered for corrosion proofing.

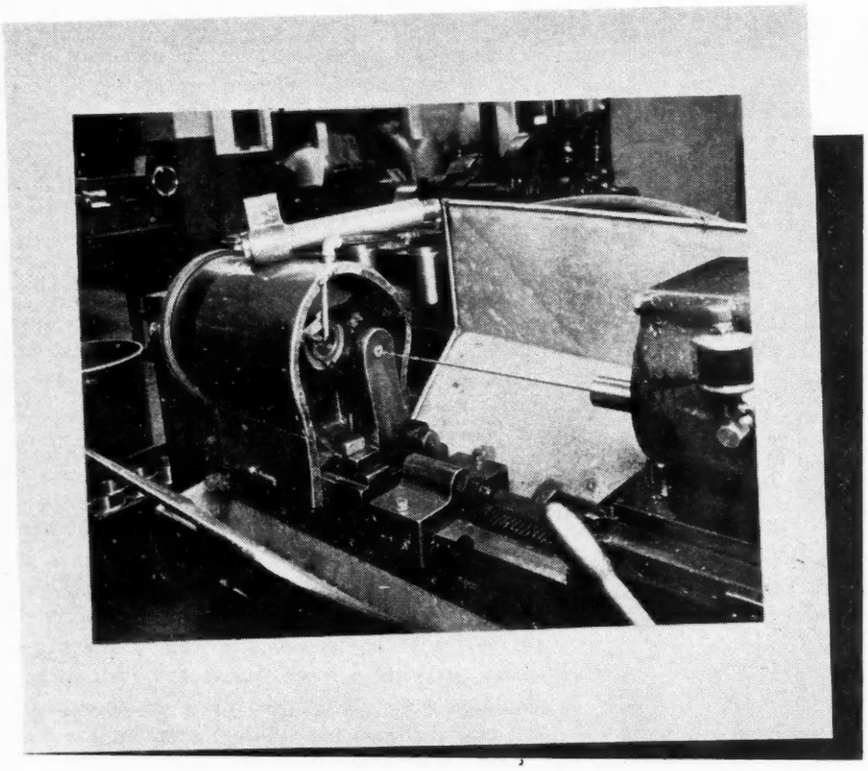
Among many machine operations one of the most interesting is the processing of the control rod with toothed sections and the control sleeve carrying a toothed segment with corresponding teeth. Both the teeth on the control rod and those on the toothed segment are cut accurately to master teeth on Fellows gear shapers.

Nozzle holders are made in six sizes and in some 50 different variations. They are produced from low carbon steel drop forgings. Turning, milling, drilling, threading and carburizing operations are followed by torch

(Above) Part of a battery of Fellows gear shapers used for cutting teeth in the control rods and in the segments with which they engage.



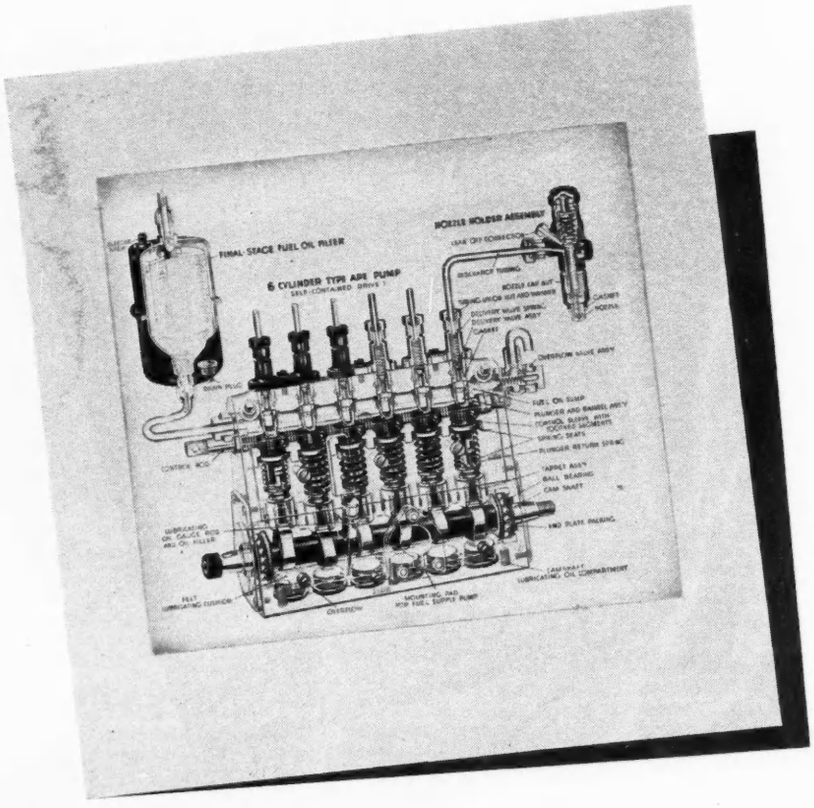
(Right) Grinding the bore of tappet roller bushings on a Heald centerless hole grinder with magazine feed. The operation follows grinding of the outside diameter on a Cincinnati centerless grinder. This procedure assures satisfactory concentricity of internal and external surfaces.



(Left) A Natco automatic drilling machine is used for drilling spindle and duct holes in nozzle holder bodies. A typical nozzle holder is shown lying across the metal guard.

hardening of the nozzle seating surface. After the seating surface has been given a 100 per cent hardness inspection it is ground and lapped. A particularly interesting operation is that of drilling the fuel duct and center bore for the spindle in Natco deep hole automatic drilling machines. In this operation the drill runs in one direction of rotation and the work piece runs in the opposite direction. This method facilitates the drilling of straight holes which may be approximately ⅛ in. in diameter and as long as 8 in. A hydraulic flow test of the nozzle holder body is made by building up a constant pressure of several hundred pounds per square inch and observing the pressure drop in the fuel duct from a specified level. If the pressure drop is too great, the ducts are cracked or broken through. When the pressure drop is too small, it is known that the ducts are restricted.

The material used for the spindle part of the nozzle holder is tungsten steel. Here again round stock is the starting point. Operations are turning and hardening. There follows a 100 per cent hardness inspection. The spindle is then straightened and ground. Careful machining of the lower end of the spindle which makes contact with the stem of the nozzle valve is particularly important in the prevention of cocking and sticking of the nozzle valve.



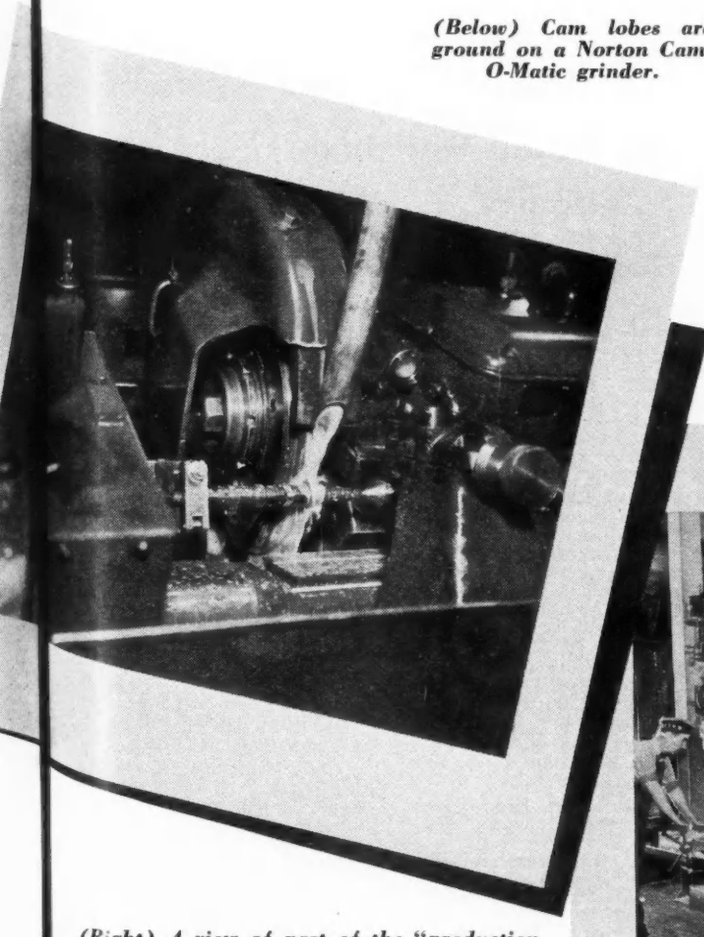
There are two basic types of nozzles: pintle and multiple hole. The former are built in three sizes, the latter in six. Pintle nozzles are made in some 100 different variations, while the multiple hole nozzles are produced in nearly 1000 different variations. Material specifications for the spray nozzles are: nozzle body—chromium-nickel steel (hardness, 48 min. Rockwell C 150); nozzle valve—tungsten steel (hardness, 56 min. Rockwell C 150). These parts are made of round stock turned, drilled, reamed and hardened. There is a 100 per cent hardness inspection followed by finish grinding, rough lapping, and finish lapping. Size and straightness of the bore in the nozzle is checked by pneumatic micrometers.

Several rigid tests are then made. First, there is a hydraulic leakage test for tightness through the valve seat.

Manufacturing Operations On Tappet Shell

	OPERATION	EQUIPMENT
1	Pump, center, drill, rough and finish turn outside diameter, rough and finish face closed end and recess at open end	No. 4 Warner and Swasey
2	Grind outside diameter	Cincinnati centerless grinder
3	Mill open end and slot	Producto miller
4	Drill, countersink and tap tappet, screw hole, drill and ream pin hole	4-spindle Allen drill press
5	Burr in and out	Kellerflex burring machine
6	Remove burr from thread	Drill press
7	Stamp	Kick press
8	Wash, blow out chips	
9	Inspect	
10	Carburize 0.3 mm. deep and harden	Cyanide pot
11	Inspect	
12	Finish grind outside diameter. Tolerance for outside diameter: **0.033 mm.** or **0.0012 in.**	Cincinnati centerless grinder
13	Finish hone pin hole. Tolerance for pin hole: **0.018 mm.** or **0.0007 in.**	Micromatic honer
14	Stone corners, wash in gas, blow out	
15	Inspect	

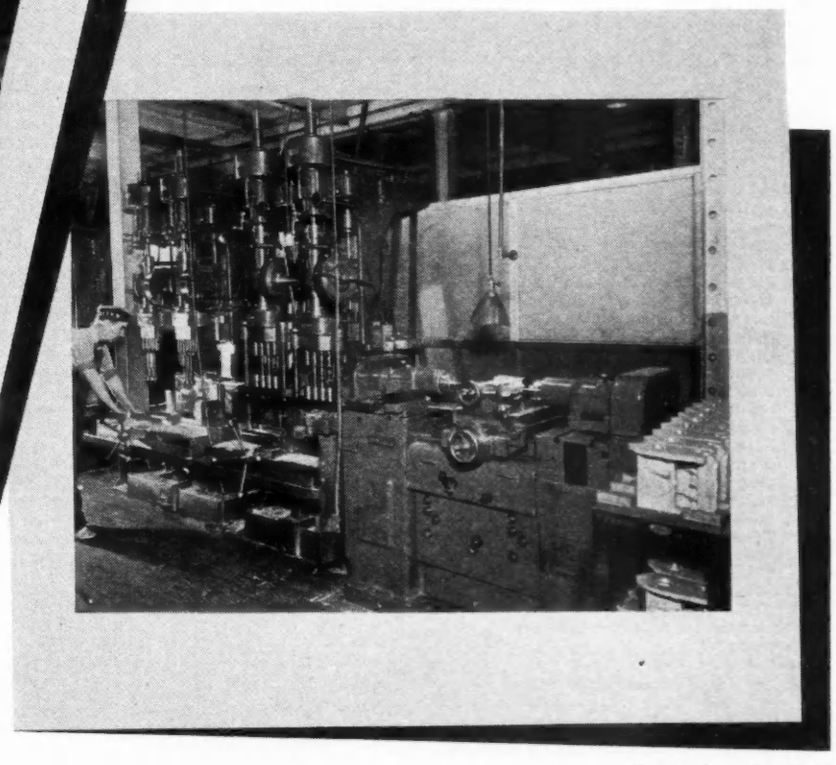
(Below) Cam lobes are ground on a Norton Cam-O-Matic grinder.



Then, a hydraulic leakage test of the fit between the valve and bore in the body is made by building up a high static pressure and observing the pressure drop from a high level to a specified lower level in a certain minimum and maximum time interval. Another test is the spray test which investigates the uniformity of the spray pattern, its freeness from core, stringiness and distortion. Throttling nozzles, in addition to being subjected to the forementioned examinations, are spray tested by means of the Stroboscope at 200, 600 and 1000 r.p.m. for a small (50 cu. mm.) and large (200 cu. mm.) quantity of fuel. In this study, spray pattern, spray penetration and spray duration are all carefully checked.

While there are very few parts of the Diesel fuel injection pumps that are adaptable to straight-line production, the plant layout at American Bosch is such that a general flow of material from "rough" machining operations to final assembly is preserved. According to this scheme, screw machines, turret lathes and punch presses are farthest away from the assembly line. Proceeding progressively through the plant, engine and turret lathes, milling machines and drill presses are next. Finally, there are the grinding machines, the high precision room, stock room, assembly line, and the shipping platform. The manufacturing set-up is efficient and modern. It includes over two hundred thousand dollars' worth of new machinery purchased during the past year.

Finished parts instead of moving to the assembly room are sent directly to the stock room. There are various reasons for this procedure. First of these is the fact that assembly operations are relatively slow as compared with the rate at which various components can be produced. Therefore it proves most economical, for instance, when an automatic screw machine is set up to produce a certain part to turn out



(Right) A view of part of the "production line" for machining the fuel injection pump housings. Allen drill presses at the left are equipped with special multiple spindle drill heads. Operations on these include rough and recessing of the oil sump; drilling and rough reaming the tappet and closing plug holes. Finish boring of fuel discharge holes, barrel seats, tappet and closing plug holes is done on the Heald two-spindle Bore-Matic.

several thousand and put them in stock. Another reason is found in one of the characteristics of the manufacturing plan wherein one machine may be used to manufacture a number of different parts. In order to make deliveries within a reasonable amount of time, therefore, an inventory of all components must be held in reserve.

Straight line production methods common to the manufacture of automobiles are not feasible in Diesel fuel injector pump manufacture. As pointed out previously there are many variations (approximately 500) in the different kinds of pumps which preclude this type of operation. It is also essential to keep the manufacturing facilities very flexible because of over 700 different specifications due to changes frequently requested by the manufacturers of Diesel engines. However, wherever possible straight-line production methods are used as, for instance, in the manufacture of the housing or the camshaft.

When an order for a quantity of one type of pump is received at the factory, the stock room makes up what is referred to as a "lot collection." The "lot collection" consists of boxes each containing the required number of parts to produce the pumps. On the same day that assembly of the lot will be started, all parts are again cleaned. A Blakeslee degreaser is used for this purpose.

Lines are established for the assembly of the major types of pumps, each being equipped with special holding fixtures. Production on the assembly lines is at a rate which permits one man to perform more than one operation. The lines are arranged so that extra men can be brought in if it becomes necessary to step up the rate of assembly. Roll curtains are installed on all assembly benches. These curtains are dropped down at night to protect assemblies and parts from particles of dust and dirt. Cleanliness is extremely important and assembly workers are trained to be exceptionally careful in this regard.

After assembly is completed the units pass to the running-in stands. Pumps are operated at constant speed and deliver fuel against high-pressure. Any chips or dirt that might have escaped previous vigilence are loosened in this run and flushed out with oil after the run is completed.

Timing of the individual plungers of the injector pumps is then carried out on special hydraulic timing test stands. The tolerance on this test is plus or minus ¼ camshaft degree for the angular spacings following the firing sequence.

In a final test the injection pumps are calibrated for

Operations On Fuel Injection Pump Housings

	OPERATION	EQUIPMENT
1	Straddle mill both ends and burr	Miller
2	Core bore and face bearing seat, form-drill control rod hole, finish ream both holes (both sides). Tolerance for bearing seat diameter: 0.025 mm. or 0.00098 in.	2-spindle Allen drill press No. 3
3	Form drill fuel entrance hole on both sides	
4	Mill top and bottom and inspect cover seat	No. 2 Cincinnati miller
5	Drill 12 and 15 mm. diameter, rough ream 16.3, 15.8 and 12.8 diameter, finish countersink 60 deg. and 90 deg. angle, finish ream 13.3-13.4 diameter, rough face barrel seat	3-spindle Allen drill press No. 3
6	Drill control rod and fuel entrance holes from both sides, burr both ends, top and bottom	
7	Drill plunger clearance	No. 11 Pratt and Whitney
8	Recess sump and thread (rough and finish)	2-spindle Allen drill press No. 3
9	Core bore plug and tappet hole 23 and 23.5 diameter, finish countersink 26.8 diameter, rough ream 23.8, 24.3 and 28.2 mm. diameters, rough face plug seat	2-spindle Allen drill press No. 3
10	Finish bore fuel discharge hole 16.5, 16 and 13 mm. diameters. Finish bore plug and tappet hole 24.0-24.5, 28.3 diameters, finish face plug seat Tolerance for barrel bore: 0.035 mm. or 0.0013 in. Tolerance for tappet bore: 0.022 mm. or 0.00086 in.	No. 49 Heald Boorematic
11	Mill keyway, counterbore pinion hole and spring seat	2-spindle Allen drill press No. 2
12	Leakage test	Bench
13	Drill countersink and tap bottom fastening screw holes	2-spindle Allen drill press No. 2
14	Form drill and ream oil gage rod hole	1 spindle Allen drill press No. 2
15	Mill pump surface	No. 1½ Cincinnati miller
16	Drill seal holes Drill and counterbore barrel set screw holes	No. 11 Pratt and Whitney multiple drill press
17	Drill, countersink, tap end plate fastening screw holes (both sides)	2-spindle Allen No. 2 drill press
18	Drill, countersink and tap, inspect cover fastening screw holes and drill dowel pin hole	3-spindle drill press
19	Drill 2 name plate holes	1 spindle drill press
20	Drill 2 name plate holes	1 spindle drill press
21	Drill and ream pump hole, drill countersink pump fastening holes and oil drain holes, tap oil drain holes, pump fastening holes and barrel set screw holes	5-spindle drill press 3-spindle Allen tapping machine No. 2
22	Drill, countersink and tap locking screw holes	2-spindle Allen drill press No. 2
23	Drill and tap 2 vent holes	2-spindle Allen drill press No. 2
24	Drill, countersink, spot face and tap control rod set screw hole	3-spindle drill press
25	Drill 2 drain holes	2-spindle drill press
26	Tap fuel discharge holes Tap plug holes	2-spindle Allen tapping machine No. 3
27	Tap 2 fuel entrance holes	1 spindle tapping machine
28	Tap 2 control rod holes	1 spindle tapping machine
29	Mill fuel pump supply slot	Bench miller
30	Finish file and burr all over, countersink barrel seat, scratch centerline	Kellerflex burring machine
31	Hand ream tappet holes	Bench
32	Spot face fuel entrance hole	1 spindle drill press
33	Wash and blow with air	Wash tank
34	Inspect	
35	Bright dip in acid, rinse in cold and hot water and blow with air	Wash tank
36	Inspect	

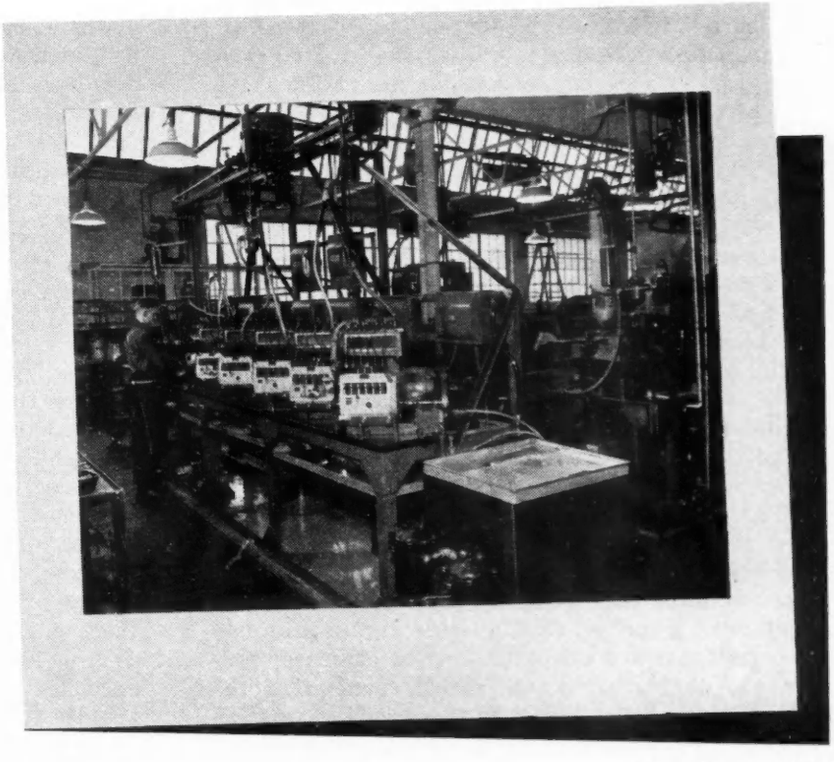
(Top) Control board in the heat treating room equipped with Leeds & Northrup Micromax potentiometer pyrometers that control the heat treating furnaces and keep accurate records of heating cycles.

(Above) One of the lapping benches where plungers are lapped into barrels. The vertical instruments to the left of each man are Hirth Minimeters, reading directly to 0.001 mm. or 0.000039 in.

uniform fuel delivery in all cylinders. The test is made on special hydraulic calibrating test stands for two different speeds, a low and a high speed, as well as for three different control rod positions or fuel deliveries and with a specified test set-up and test oil.

American Bosch has excellent facilities for handling the various heat treating operations to which different parts of the injection fuel pumps must be subjected. One job for which Leeds & Northrup Homocarb furnaces are used is the carburizing of the injector pump camshaft, for which specifications require a case depth of 0.060 in. Incidentally, an American Bosch injection pump is used to provide accurate control of the amount of oil injected into the furnace.

For heat treating injector pump plungers and barrels, Leeds & Northrup Vapocarb furnaces are employed. This is strictly a heating process and oil is used to create a protective atmosphere that will prevent scaling. Each furnace has an auxiliary crack-



(Right) After assembly, and before calibration and timing, the fuel injection pumps are "run in" for at least one-half hour. The pumps are flushed with oil before and after this operation on the flushing stand which may be seen at the extreme right.

Examples of Close Tolerances On Fuel Injection Pump Parts

Part	Dimension	Tolerance In mm.	Tolerance In Inches
Plunger	Shank diameter (size)	0.004	0.000157
Plunger	Shank diameter (taper)	0.001	0.000039
Barrel	Hole diameter (size)	0.004	0.000157
Barrel	Hole diameter (taper)	0.002	0.000079
Barrel	Shank diameter	0.009	0.000354
Delivery valve	Valve stem diameter	0.002	0.000079
Delivery valve seat	Hole diameter (size)	0.004	0.000157
Delivery valve seat	Hole diameter (taper)	0.002	0.000079
Nozzle valve	Valve diameter (size)	0.005	0.000197
Nozzle valve	Valve diameter (taper)	0.001	0.000039
Nozzle valve	Spray pintle diameter (only 1 mm.)	0.005	0.000197
Nozzle body	Valve hole diameter (size)	0.004	0.000157
Nozzle body	Valve hole diameter (taper)	0.002	0.000079
Nozzle body	Spray hole diameter (only 1 mm.)	0.005	0.000197
Nozzle body	Valve seat angle	5 min.	
Nozzle assembly	Clearance between spray pintle and spray hole	0.005	0.000197

ing unit from which the cracked gases pass into the furnace itself. These furnaces may be used also for carburizing, providing the flow of oil is increased.

All alloy steel parts, such as plungers and barrels, must be tempered to remove strains. There are several tempering operations performed on these parts, one after hardening, another after rough grinding, etc. The reason is obvious. Limits are so close that no chance can be taken of any possible warping to cause distortion of a part in service. Leeds & Northrup Homo Air-Tempering furnaces are available for this work.

Tungsten steel parts, such as the nozzle valve, are heat treated in Hayes high-speed furnaces equipped with the "Certain" curtain. All high-speed tools also are hardened in the Hayes furnace.

Each furnace in the heat treating department is connected with a Leeds & Northrup Micromax instrument which records the furnace temperature. The instruments, assembled on a large panel, facilitate the accurate control of temperature. Charts are preserved for reference.

Provisions have been made for the maintenance of a constant temperature of the quenching oils. A main oil reservoir is located in a sump under the floor in the heat treating room. The oil is circulated from the sump and, if it becomes too hot, may be passed through a cooler.

Where only light cases are required, a Westinghouse pot type electric furnace, sometimes referred to as a "salt pot," is used. Parts, such as screws, nuts and bolts, would be handled in this equipment.

American Bosch not only occupies a prominent position in the fuel injection field, but is a well-known name in the ignition field, being a large magneto manufacturer. The company also produces ignition coils, electric windshield wipers and other automotive electrical equipment such as ignition timers, distributors and generator regulators. More than 1200 persons are employed at the plant in Springfield, Mass., which was built in 1910 and has at present over 300,000 sq. ft. of floor space.

Operating Temperatures of Cylinder Barrel on Aircraft Engines

SOME figures on operating temperatures of cylinder barrels and heads of the engines of three airplanes largely used in the services of Air-France were given in a paper presented to the (French) Society of Civil Engineers recently by M. J. Becq. The three planes concerned are the twin-engined Potez 62, a 10-passenger plane of 16,500 lb. weight with a cruising speed of 155 m.p.h.; the twin-engined Bloch 220, a 16-passenger plane of 21,000 lb., with a cruising speed of 184 m.p.h., and the trimotor Dewoitine 338, a 22-passenger plane of 25,400 lb., with a cruising speed of 171 m.p.h.

Although the cooling systems of these planes are not in accordance with the latest scientific developments, in the hands of skilled pilots they permit of continuous operation, winter and summer, in any latitude.

Improved and in some cases entirely new types of cowling were developed for these three planes. The successive modifications all resulted in increasing the air pressures ahead of and behind the cylinders (0.45 lb. per sq. in. in the case of the Bloch 220) and in improving the distribution of the air currents around the barrels, led to a diminution of the entrance openings, the diminution of the inside diameter of the leading edge of the N.A.C.A. type cowling whereas the diameter of the fixed screen behind the propeller or the diameter of the propeller hub was increased to 23.5 and even 27.5 in. Finally, efforts were made to suppress all turbulence at the exit from the cowling, as such turbulence is detrimental to the control surfaces. The temperatures resulting from these improvements were as follows:

Potez 62	Head 329 deg.	while cruising	446	In flight with one engine dead.
	Barrel 158		221	
Bloch 220	Head 338		428	
	Barrel 158		230	
Dewoitine 338	Head 329		392	
	Barrel 158		221	

The efficiency of the cowlings has a very favorable effect on the endurance of the equipment. On Nov. 1, 1938, nine Potez 62s had completed 6600 hr. of flight, 15 Bloch 220s, 5400 hr. A flight of 30 hr. with one engine dead, under full engine power, was made as an experiment and for the training of the personnel, without any special precautions being taken. During the same time the periods between overhauls at the factory were increased as follows: For the Gnome-Rhone engine from 500 to 600 hr.; and soon thereafter to 700 hr., with an average of one cylinder disassembled per 350 hr. None of the engines which exceeded 500 hr. had any trouble.—*Technique Moderne.*

AUTOMOTIVE INDUSTRIES

Just among Ourselves

As THIS was being written the Chrysler-Union negotiations had reached the stage where union negotiators were seeking a cash advance for the striking workers so that they could buy Thanksgiving dinners for their families. It doesn't seem unfair to point out, under the circumstances, that if there had been no strike the great majority of the workers would have been able to buy adequate Thanksgiving dinners for their families. Nor does it seem unreasonable to question the propriety of asking for a "handout"—a charitable donation—from someone whom you have just been trying to sandbag into acquiescence in a labor contract.

It reminds us a little of the Shakespearean actor—at liberty for many years—who used to sit around hotel lobbies in the town where we went to school. A strange face was a signal for him to approach, with a dignified bow, and begin a pompous speech on the decline of the acting profession, and the lack of appreciation for the true art of declamation. If this part of the speech got over, the second phase consisted of offering the stranger a rare, and unequalled opportunity to listen to any part of any of Shakespeare's plays—recited from memory—by one who had been trained in the true, the great school of acting. If this got across, the third phase of the approach linked the unusual opportunity with the fact that Brother Thespian would condescend to accept a dollar for the private—the strictly private—performance.

Nine times out of ten, this was a signal for the stranger to begin to squirm and look for an out. When the symptoms got too acute to ignore, the gent in the fur fedora would sigh deeply and say:

"Well, anyway, if you'll give me a nickel for a cup of coffee I'll go away and let you alone."

A Commendable Record

The Michigan football team came down to Philadelphia the other day and tore a game away from a fighting University of Pennsylvania team. With the Michigan team came the magnificent Michigan band. The presence of the band was made possible through the cooperation of Harlow H. Curtice, general manager of the Buick Division of General Motors.

Day before the football game, Mr. Curtice and some members of his own factory team presided at a luncheon in honor of John Costello who resigned as Buick zone manager in Philadelphia to take a Buick dealership in Syracuse.

A luncheon in honor of a departing zone manager is not especially important in itself. But this particular luncheon was important, not only as a testimonial to a particularly well thought of member of the zone-manager clan, but because of some of the things it brought out about Buick and H. H. Curtice.

Harlow Curtice became general manager of the Buick division in October of 1933. The division's prestige was at low ebb, and sales for that year were a fifth of what they have climbed to in subsequent years. The sales record speaks for itself. Many a record like that has been accompanied with a wholesale house cleaning of the staff. The classic procedure is for the incoming new broom to raise a lot of dust.

The accomplishments of Mr. Curtice at Buick have, generally speaking, utilized the same manpower he found when he went in as general manager. The transfer of zone managers such as that signalized by the party mentioned above was the first in the six years Mr. Curtice has headed Buick. To this observer that's quite a (commendable) record.

The Balance Sheet Shows—

One of the most interesting third-quarter financial reports is that of the Borg-Warner Corp., which, in the first nine months of this year converted a loss of more than a million dollars for the same period of last year into a profit of three times that size. Probably the most significant ratio in the Sept. 30 balance sheet of this corporation is the tax figure. In 1938, for nine months, Federal and Dominion income taxes cost the company $29,573. For the first nine months of this year, the burden was $994,605, or about 33 times as great. It took mathematics nearly two thousand years to progress from Euclid to Descartes. The tax gatherers seem to have discovered just about as much concerning geometric ratios in a couple of hundred.

100 per cent Salvage

The Auburn Automobile Co. and the Central Manufacturing Division are still actively in business under the direction of Roy Faulkner. From the manufacture of automobiles they have turned to the manufacturing of diversified metal products on a contract basis. Nearly every type of machine used in the old set up has been put to work, and many of the men who were employed on Auburns and Cords have been kept on the payroll at other tasks. The whole business is one of the most remarkable salvage jobs in the history of the automotive industry. A lot of credit goes to the man and the organization responsible for putting it across.—HERBERT HOSKING.

Test Laboratory Has

A NEW automotive laboratory recently completed at the Point Breeze (Philadelphia) refinery of the Atlantic Refining Company is equipped with the most up-to-date apparatus employed in testing fuels and lubricants. The principal equipment consists of chassis and engine dynamometers, special fuel-testing sets, and friction- or bearing-testing machines. Fuels and lubricants can be tested under both laboratory and road conditions.

The laboratory is a separate building of concrete-block construction, with a floor area of approximately 10,000 sq. ft. Fuel, water, vacuum and air lines, and lines for the disposal of exhaust and waste gases are located in trenches in the concrete floor of the building. An overhead trolley makes it possible to readily mount engines on any of the various dynamometer stands. Walls and doors of the cold rooms are heavily insulated with cork, to maintain the desired temperature and to deaden noise. Cork pads are provided in the foundations of the test stands to absorb vibration.

The building itself and the interior lay-out were designed by Atlantic's Engineering and Construction Department in cooperation with engineers of the Automotive Laboratory. Prior to preparing the plans, a thorough preliminary study was made of other automotive laboratories and of recently developed equipment.

Severe winter-operating conditions can be simulated even in mid-summer, by means of a refrigeration and blower system which supplies cold, dehumidified air at velocities of up to 70 m.p.h. to the chassis dynamometer test room, and an adjacent cold room for engine tests. A third cold room is provided for small test equipment, such as rear-axle, transmission, and other lubricant-testing devices. The temperature of each of these rooms can be held at anything from 20 deg. below zero Fahr. to 120 deg. above zero. Refrigeration is supplied by two 50-hp. and one 15-hp. automatically controlled Freon compressor units with an ice-making capacity of 88 tons per day at an atmospheric temperature of 60 deg.

In the chassis dynamometer test room the behavior of fuels and lubricants in passenger cars and trucks can be determined under widely varying conditions of temperature, wind velocity, and load. The car or truck is blocked in position, with the rear wheels

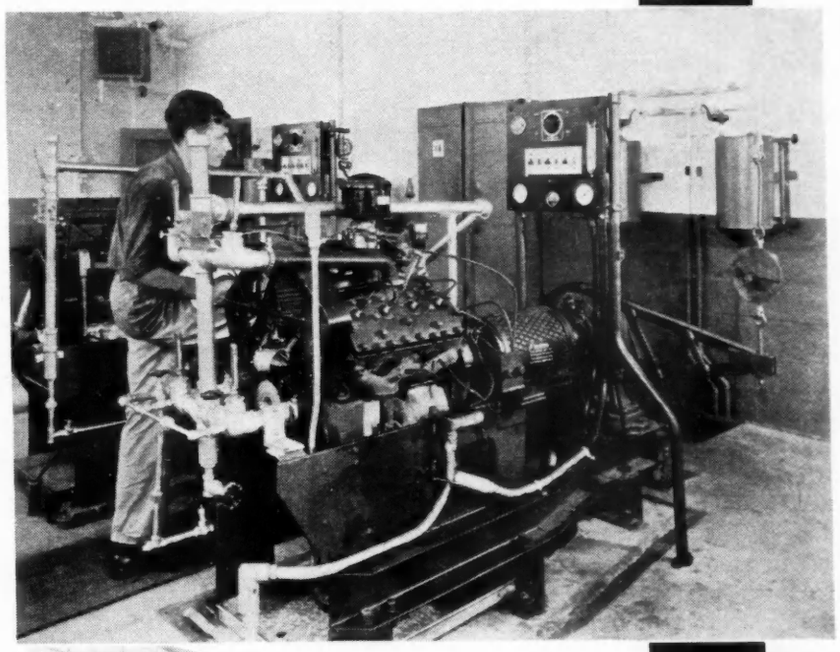
A view in the chassis dynamometer room. Refrigerated air, at velocities up to 70 m.p.h. is blown into the room through the opening directly in front of the radiator. The cables extending from the side of the car lead to the dynamometer control panel, while the tubes rising from the air inlet connect a Pitot tube with a pressure gage which indicates the air velocity.

Unique Control

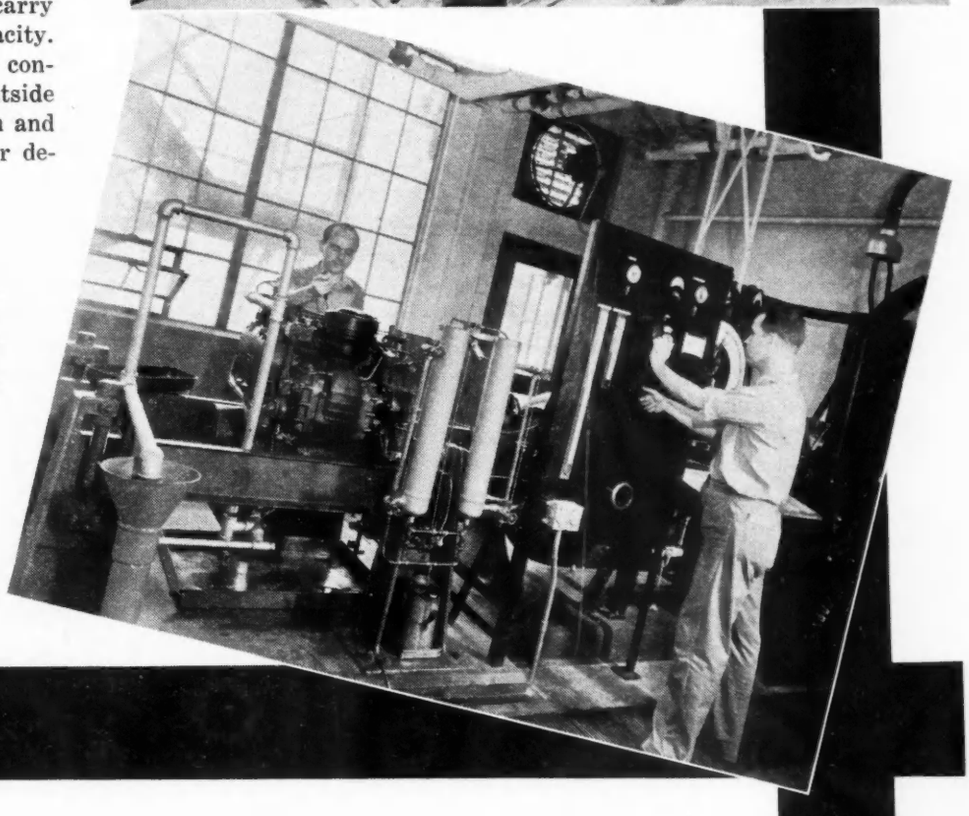
Regulation of the equipment is effected from the seat of the car being tested instead of the usual wall panel adjacent to the stand

resting on a pair of wide rollers flush with the floor of the room, the shaft of the rollers being direct-connected to a 150-hp. electric dynamometer in an adjacent room. This makes it possible to measure the power developed on the driving wheels of the vehicle under test.

There are two innovations in the chassis dynamometer installation, and both have to do with control features. As a rule, in a chassis dynamometer room there is a control panel on the wall adjacent to the side of the electric dynamometer, by means of which the load imposed on the car engine by the dynamometer can be varied. By varying the electric load on the dynamometer, and its field strength, the engine can be made to run at any speed and to carry any torque load within its capacity. In the Atlantic laboratory the control panel may be located outside the chassis dynamometer room and the various switches and other de-



Complete set-up on one of the six hydraulic dynamometers. Each of these dynamometers is capable of absorbing more than 200 hp. and of operating at 4400 r.p.m.



Dynamometer set-up for test on a two-stroke Diesel truck engine. The 300 hp. electric dynamometer to which the engine is connected is behind control panel.

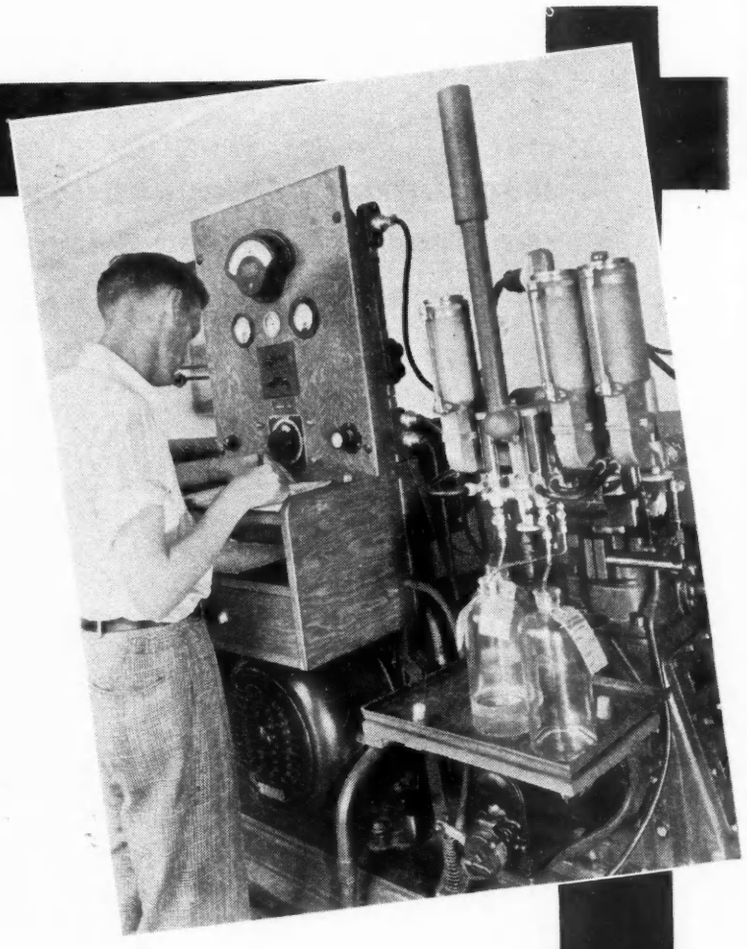
vices on the control panel may be controlled by the driver from inside the car by means of a control box about the size of a small suitcase. The advantage of this system over that in which the man in the driver's seat gives instructions to an attendant at the control panel is self-evident.

When the apparent speed of the car is varied by means of the dynamometer controls, it is necessary to also vary the air speed, and this can be accomplished by means of a switch placed on the driver's seat in the car. The large blower fan is driven from an electric motor through a fluid coupling in which there is a certain amount of slip under all conditions. This slip depends upon the torque load transmitted and upon the amount of fluid in the coupling. An electrically driven pump, therefore, is combined with the coupling by means of which oil can be pumped into or out of it, and the speed of the blower varied, the electric motor running at substantially constant speed. By varying the air speed with the apparent speed of the car on the chassis dynamometer, road conditions with respect to engine cooling can be simulated.

While the chassis dynamometer room—38 ft. long by 15 ft. wide by 14 ft. high—is large enough to accommodate most trucks now made, the insulated doors separating it from the adjacent cold room for engine tests can be thrown wide open, thereby increasing its length to 53 ft. to accommodate any abnormally large vehicle.

This adjacent cold room is intended primarily for starting tests and other tests of fuels of varying volatilities and of oils of varying viscosities, with the engines operating at low temperatures. The test engine is placed on a permanent foundation and can be connected to a 300-hp. dynamometer in the next room by a shaft extending through the wall.

The room in which the 300-hp. dynamometer is installed is equipped also with engine stands, so engines can be tested on the dynamometer either while in the same room with it, or in the adjacent cold room. Tests on large gasoline and Diesel truck engines are made in this room. An investigation now under way relates to the fuel and lubricant requirements of different types of automotive Diesel engines. There are direct-injection and prechamber types of Diesel engine, two-stroke and four-stroke, and there may be variations with respect to the fuel volatility and cetane requirements as well as with respect to lubricant requirements between these different types. Tests, therefore, are being run at present on two engines which are regarded as representing extremes with respect to both fuel and lubricant requirements. One is a two-stroke engine with direct injection into the combustion chamber, the other a four-stroke engine with high turbulence induced by an auxiliary air cell or energy cell. It is felt that any fuel and any lubricant meeting the requirements of these two engine types will be satisfactory for the whole range of automotive Diesel engines.



Determining the octane number of a gasoline on one of the three single-cylinder, variable-compression, knock-testing engines in the room for evaluating experimental fuels.

Two other dynamometer rooms contain, respectively, a 75-hp. and a 45-hp. electric dynamometer. Either of these dynamometers may be used for cranking tests and frictional horsepower runs on smaller passenger-car engines. A third room contains six hydraulic dynamometers, each capable of absorbing more than 200 hp. and designed to operate at speeds up to 4400 r.p.m. Tests for lubricating oil stability and engine wear, as well as evaluations of experimental motor oils, are made in this room.

Tests of the octane or anti-knock value of blends, and of experimental fuels are conducted in the knock-testing room on three standard knock-testing engines. These are of the single-cylinder, variable-compression

(*Turn to page* 606, *please*)

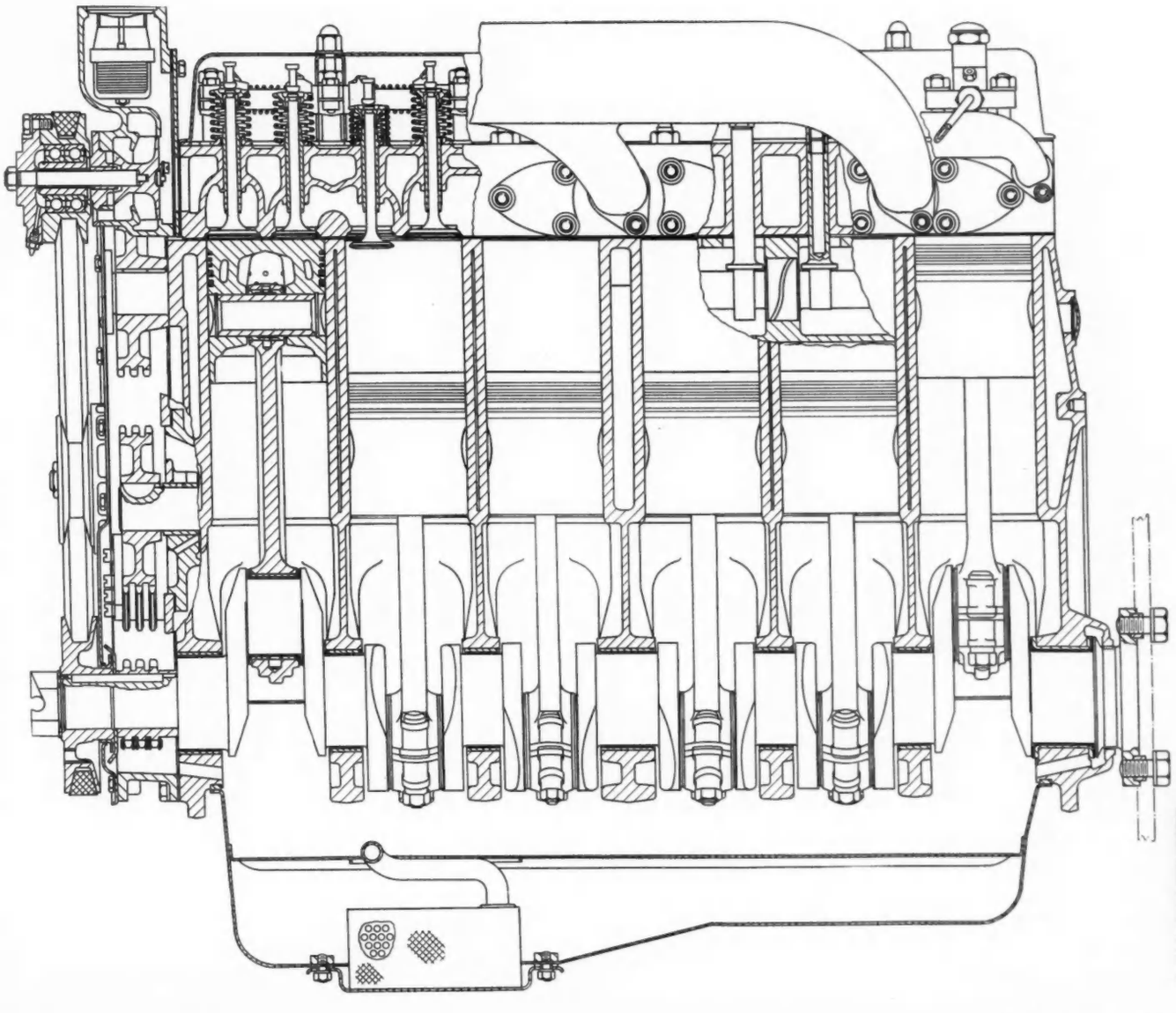
PERKINS Type P.6 DIESEL ENGINE

Longitudinal Section

Claimed to be the world's lightest Diesel engine, the Type P.6 Perkins is the largest of a series of six stock oil engines made by Perkins Limited, Peterborough, England. It has a piston displacement of 288.5 cu. in., the bore and stroke being 3½ x 5 in. The speed range is from 300 to 4,000 r.p.m.; the maximum torque, 193 lb.-ft. at 1,500 r.p.m.; the maximum b.m.e.p., 100 lb. per sq in. at 1,500 r.p.m., and the power output, 85 b.h.p. at 2,600 r.p.m., the latter being the normal governed speed.

The weight of a typical installation, including flywheel, bell-housing, starting motor, fuel pump, etc., is 712 lb., or 580 lb. without electrical equipment and flywheel.

Overhead valves are operated by a high camshaft, eliminating pushrods. Cylinder block and crankcase are a chromium-iron casting with pressed-steel sump. The seven-bearing crankshaft is of nickel-chrome-molybdenum steel and has journals of 2¾-in. diameter and pins of 2¼ in. Top halves of the bearing liners

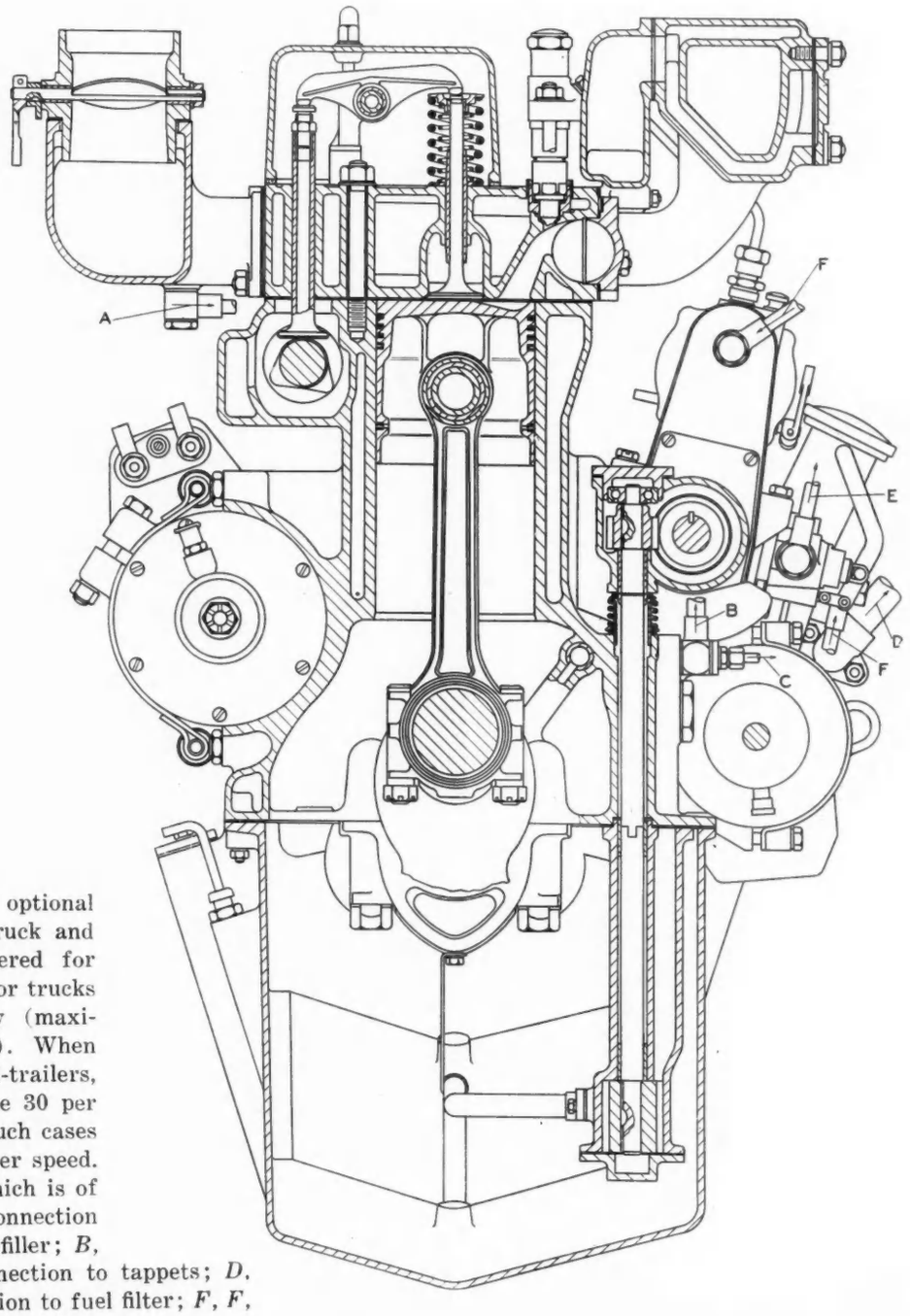


PERKINS Type P.6 DIESEL ENGINE

Transverse Section

are of white metal, bottom halves of lead bronze. Camshaft drive is by a triple roller chain, with automatic tensioner and damper. The aluminum-alloy pistons have three pressure rings and two scraper rings, one of the latter above the piston pin. Filtered air is drawn through the crankcase for the ventilation of the latter.

The chromium-iron cylinder head contains air-cell-type combustion chambers, and the injectors deliver two sprays, one into the air cell, the other toward the cylinder. Starting is said to be as easy as with an undivided combustion chamber. The Bosch fuel pump is equipped with a pneumatic governor; the idling speed can be varied by the driver. It is claimed that the combustion system causes the timing to be automatically varied to give maximum efficiency at all loads and speeds, rendering mechanical variable timing unnecessary.



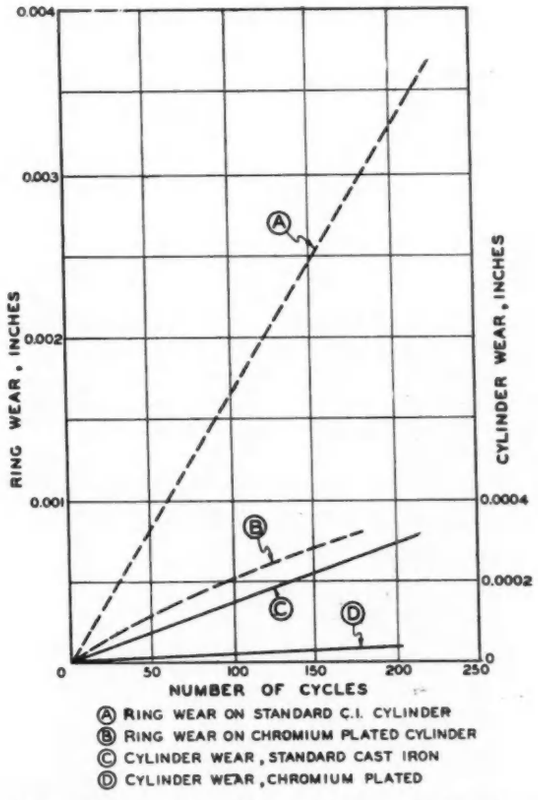
This engine is standard or optional equipment of several British truck and bus manufacturers and is offered for buses with up to 32 seats, and for trucks with 4½-5½ ton load capacity (maximum gross load, 8 long tons). When used for tractors hauling semi-trailers, the maximum gross load can be 30 per cent more than 8 tons, but in such cases the engine is governed at a lower speed.

In the transverse section (which is of a 4⅜ by 5 in. engine) *A*, is a connection for a breather pipe to the oil filler; *B*, connection to oil filter; *C*, connection to tappets; *D*, water pipe to cooler; *E*, connection to fuel filter; *F*, *F*, connections to fuel supply.

Chrome Plating Cylinder Bores

DURING the past six or seven years there has been a great deal of discussion on the subject of cylinder wear, and one of the methods proposed to reduce it, and incidentally to reduce the wear of piston rings, consists in providing the bore with an electrolytic coating of chromium. A process of chromium-plating the bores of cylinders has been developed by the Dutch engineer H. Van Der Horst. It has come into rather extensive use in various European countries, and Mr. Van Der Horst has been in this country for some time and has, we understand, succeeded in interesting at least two manufacturers of internal combustion engines in it.

The idea of trying chromium plating for cylinder bores occurred to Mr. Van Der Horst as the result of reading an article in which it was hinted that cylinder bore wear might be due more to corrosive attack than to abrasion. He was an expert in chromium plating, and he naturally felt that if he could get a coating of chromium to adhere properly to the cast iron of the block, there would be little risk of the bore being attacked chemically by products of combustion. The process is referred to as chromium hardening, rather than chromium plating, and Mr. Van Der Horst admits that "chromium-hardening" may not be correct scientifically but was chosen because in Holland the alternate term of chromium plating was apt to conjure up visions of peeling bicycle handlebars and, therefore, was hardly calculated to engender faith in the new process. Besides, a thick coating of chromium is very hard, and at that time automotive engineers were of the opinion that hardeners would aid greatly in reducing cylinder-bore wear.



Rates of wear with plain cast iron and chromium-plated bores

The problem as it presented itself had three phases, as it were, these being as follows:

1. How to obtain a thick coating of chromium on a cast-iron cylinder bore, one that would be of uniform thickness all around the cylinder and also from top to bottom.

2. How to deposit chromium in such a manner as to produce a good running surface. This is very important.

3. How to carry through the process on a production basis.

Promising results were soon obtained with engines of both the Diesel and gasoline types. Since then the process has been adopted for stock Diesel engines by the British firm of R. A. Lister & Co. and a number of reports of wear tests on bores and piston rings with engines having the bores chromium plated by the Van Der Horst or Lemet Chromium process have been published.

It was found during the early part of the development work that the so-called bright-chromium plating process will not serve the purpose, as the coating will not hold oil. In some types of high-speed engines trouble was caused by bright chromium coatings only in one engine out of about ten. But when trouble did occur it was of the nature of scoring. Absolute seizure does not occur, and one is not aware of any trouble while the engine is running. It appears that tiny chromium crystals break out of the coating, embed themselves in the piston skirt, and then start scoring, producing an area of fine scratches. Such a field of fine scratches naturally improves the oil-holding properties of the surface. It appears, moreover, that this tendency to score is more pronounced in engines with

(*Turn to page* 592, *please*)

Study of Injection Requirements

resulted in equipment satisfactory from the

By LLOYD E. JOHNSON*

IN BUILDING a new line of Diesel engines, a manufacturer naturally casts about to find suitable vendors of special equipment. With fuel injection equipment it is rather difficult to predict a design sufficiently long to justify withdrawing units from vendors' stocks. The necessity for changes and improvements at short notice often places demands for special treatment of fuel pumps and injection valves.

The Caterpillar Tractor Co., in building a line of high-speed Diesel engines for tractor use, found it highly desirable to engineer and manufacture its own fuel injection system. This policy enabled the company to modify at will the design or production of units to meet requirements as fast as conditions changed.

The manufacture of fuel-injection equipment required the immediate establishment of testing and research facilities to analyze the performance of the units built and to study them in order to direct future progress. The building of high-speed injection systems up to that time had been confined to a very few manufacturers, and was considered almost a secret art. Little had been revealed by manufacturers who specialized in building such equipment, of their knowledge of injection phenomena, outside of their patent claims. Studies of independent research laboratories in this field dealt with general considerations of all types of systems.

* Paper presented at the Fuel-Injection Symposium held at the Engineering Experiment Station of The Pennsylvania State College, May 22-23, 1939, and prepared from data obtained in experiments at the Engineering Research Laboratories of the Caterpillar Tractor Co.

The research engineers at Caterpillar Tractor Co. had to learn from the systems themselves what seemingly insignificant dimensions might be critical, what factors were important or unimportant in a system for the engine. A company manufacturing one type of Diesel engine naturally studies injection equipment from the standpoint of performance requirements for that engine alone. The injection research, therefore, has been conducted to determine the answers to these three questions:

1. What are the injection characteristics required for optimum performance of the combustion system employed?

2. How can these desired characteristics be built into the injection system?

3. What design features can be incorporated into the system that are particularly desirable from a manufacturing and service-life standpoint?

The pre-combustion chamber combustion system has been selected as especially satisfactory for duty requiring good performance over a wide load and speed range under both ideal and adverse operating conditions. A combustion chamber arranged as shown in Fig. 1 has been used. Approximately 28 per cent of the clearance space is in the pre-chamber, and most of the balance is in the cup of the piston just below the burner tube opening. Four sizes of cylinders are built at present—a 3¾ by 5 rated at 1525 rpm., a 4¼ by 5½ rated at 1400 rpm., a 5¼ by 8 rated at 900 rpm., and a 5¾ by 8 rated at 850 rpm. for tractors and a 900 rpm. for stationary engine installations.

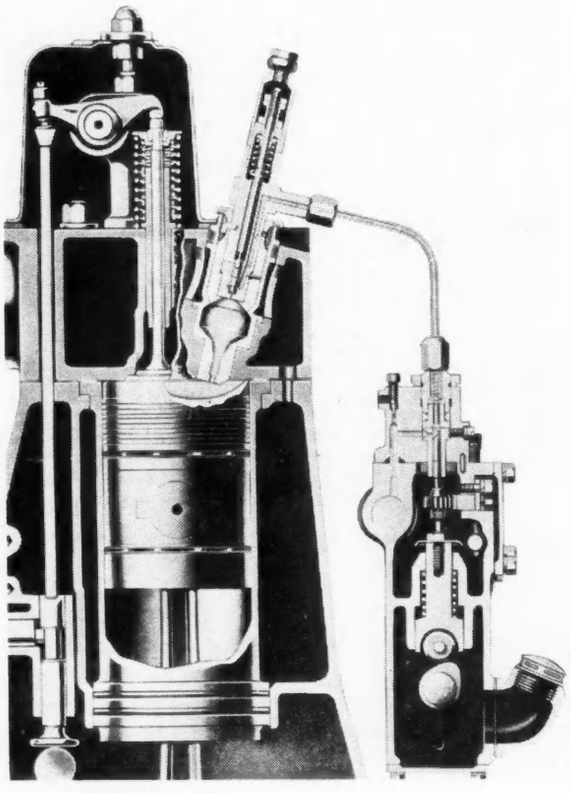


Fig. 1—Cross-sectional view of 4¼ by 5½-in. Caterpillar Diesel engine showing arrangement of pre-combustion chamber and shape of clearance volumes.

# of High Speed Diesels

that gives good performance and is manufacturing and service standpoints

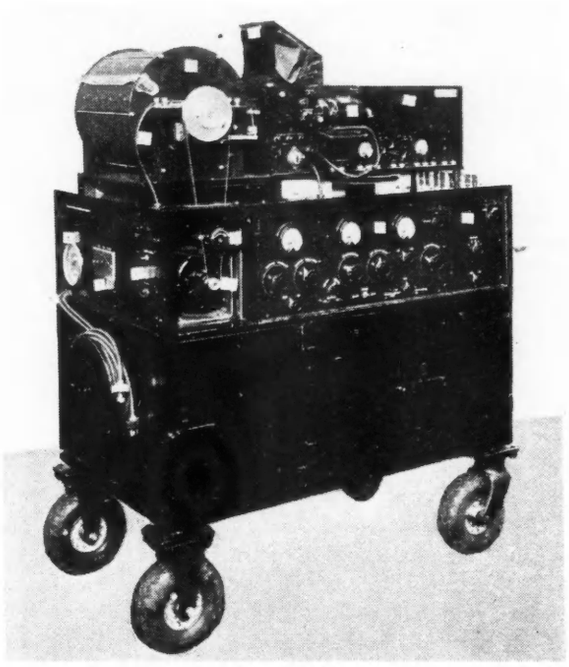


Fig. 2—Westinghouse recording oscillograph used by the Caterpillar Tractor Co. Research Laboratories to record high-speed engine and injection-system phenomena.

Injection and Ignition Timing

The pre-combustion chamber is almost unique in its ignition characteristics. In the process of development of such a system for an engine, the first step has been to select a shape and size of burner tube for optimum operation at the maximum rated speed. Clear exhaust, short ignition lag, and the desired bmep. at that speed have been obtained by systematic experimentation. When it has been desired to determine the proper timing for injection beginning at other loads and speeds, such a system has been found under nearly all conditions to require the fuel to start entering the pre-chamber at a constant crank-angle before top dead center. Ignition lag has proved to be a constant crank angle instead of a constant time interval.

Such timing very likely has been due to the rapid increase, with speed, in the velocity of the air stream shooting into the pre-chamber directly counter to the incoming spray of fuel. The faster the two streams met, the more rapid was the breaking up, heating, and vaporizing of the outside envelope of spray. An ignition lag of four crank degrees at engine speeds of 1800 rpm. has not been considered unusual.

To determine the lag between injection beginning and cylinder pressure rise, either of two methods has been employed. The more direct, but nevertheless longer, way of the two has been to use a Westinghouse decording oscillograph of the galvanometer-deflected light-beam type. This instrument, pictured in Fig. 2, recorded simultaneously on a film a cylinder pressure-time diagram, a rate-of-pressure-change diagram, an injection-needle lift-curve, and a marker which indicated top and bottom dead center. As the distance between breaks in the marker line on the developed film represented 180 degrees, the crank angle between injection valve opening and the start of cylinder-pressure rise due to combustion could be measured. Fig. 3 is a reproduction of a typical diagram obtained.

The second method, while indirect, has given results that check well with those that have been obtained by the method just described. Injection systems, before being operated in a test engine, have been checked

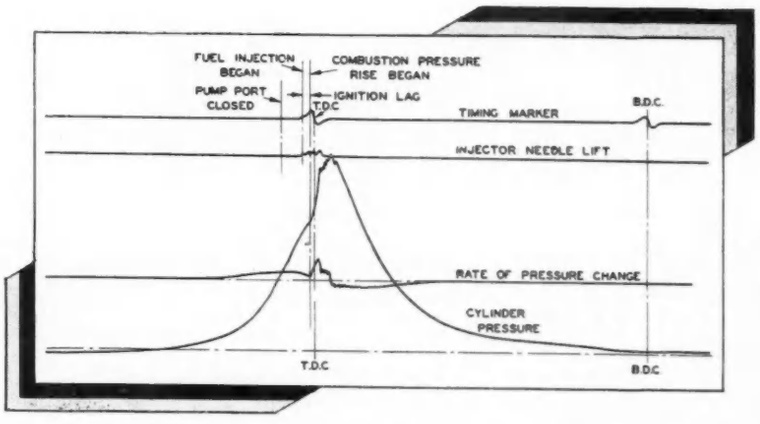


Fig. 3—Four simultaneously-recorded curves obtained with the Westinghouse oscillograph from a 4¼ by 5½-in. Caterpillar Diesel test engine developing 80 bmep at 1400 rpm.

for timing by use of a high-speed stroborama synchronized with the drive of the research laboratory's fuel-system test bench shown in Fig. 4. Time of injection beginning has been determined with this equipment within one-quarter cam degree for any engine speed and with injection quantities corresponding to any engine load. In operation, the cam angle at which the stroborama flash occurs could be varied until the first tip of the fuel spray could be seen coming from the nozzle. The number of cam degrees lag between pump-port closing and injection beginning could then be read from a vernier scale on the stroborama synchronizing mechanism.

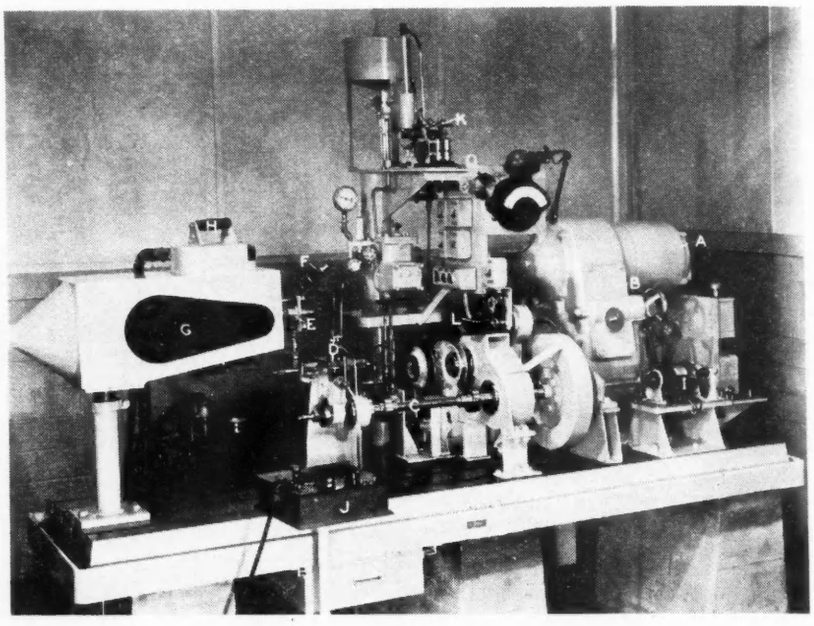


Fig. 4—Equipment used to study fuel injection system characteristics. A, two-speed driving motor; B, variable-speed drive; C, fuel-pump-cam drive shaft; D, fuel-injection pump; E, fuel-injection valve; F, injection-line pressure indicator; G, spray chamber; H, Stroborama neon-tube flasher; I, Stroborama flash synchronizer; J, flash-timing control board; K, balance for determining fuel delivery rate; L, revolution counter with solenoid-actuated clutch.

Then, during the testing of the system in a test engine, the total lag between pump-port closing and start of pressure rise was measured. Start of combustion-pressure rise could be seen as a sudden rise in the rate-of-pressure-change diagram on the screen of the cathode-ray oscillograph. The oscillograph is connected to a piezo-electric crystal pressure pickup in the cylinder head. The difference between the total lag between port closing and combustion pressure rise and the injection system lag, as determined on the spray machine, was considered the ignition lag.

Fig. 5 is a graph of lag in crank degrees plotted against engine rpm. for an engine lugged down from rated speed at rated load bmep. The top curve indicates total lag, the middle curve indicates the injection-system lag, and the bottom curve represents the difference between the top two curves, or the ignition lag.

Such a uniform ignition-lag characteristic has not eliminated injection timing problems, as injection systems tend to change timing with changes in speed. Timing changes due to the injection system have seldom been serious enough to make the addition of a governor-controlled sliding-spline or some other cam-angle phase-changing mechanism advisable, but if left to chance, poor injection system timing can cause loss of power and economy, cloudy or too hot an exhaust, or noisy operation at certain loads and speeds.

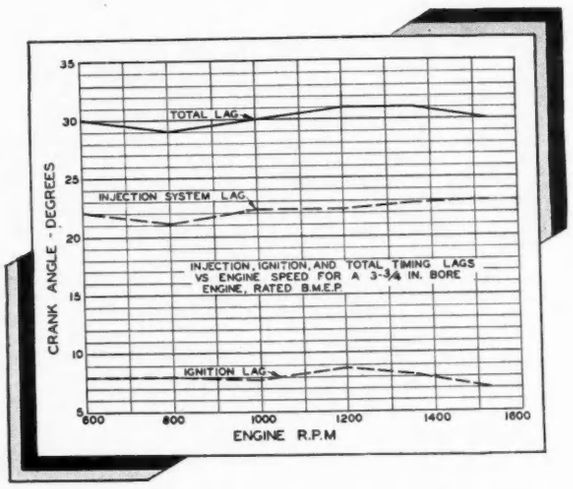


Fig. 5—Effect of engine speed on injection system and ignition tag of a Caterpillar pre-combustion-chamber Diesel.

The factor considered as first affecting timing of an injection system is the action of the port as the plunger closes it. Considerable error is introduced if the pressure in the pump is assumed to rise suddenly at the instant the port is closed. Fig 6 is a series of curves of pressure, at several engine speeds, necessary for the fuel above the plunger to flow through the restricted area between the plunger and the top edge of the port. A coefficient of discharge of 0.75 was assumed as probable in calculating them. The port diameter was 2.5 millimeters, the plunger diameter was 8.000 millimeters, and the plunger velocity at an engine speed of 1400 rpm. was 1.2 feet per second. If the pressure necessary to unseat the discharge check-valve against its spring, plus the residual line pressure, should be 400 lb. per sq. in., the intersections of the horizontal broken line with the curves indicate the crank degrees before bypass closing at which check movement would start at the different speeds. It is evident that the pressures can be expected to build up several degrees earlier at high than at low speeds, and therefore, to attain higher values by the time the port is actually closed.

The smaller the port, the earlier will be the build-up at any given plunger speed. For the same port and rate of fuel displacement, a large-diameter, slowly-moving plunger will produce earlier pressure rise than a small-diameter, fast plunger. As the rest of the factors of the injection system tend to produce increased lag with increase in operating speed, as small

a port as will give adequate volumetric efficiency at top speeds has been used, and plungers of fairly large diameter-to-effective-stroke ratio have been preferred.

The pump pressure developed acts first to displace the check valve. The inertia of the check is more than nine times that of an equal volume of fuel oil, and whereas most of the oil in a system is accelerated by the front ramp of a pressure wave in the time necessary for the wave to travel the length of the line, the check must be accelerated as a whole by the differential action of pressures built up at the ends.

Professor K. J. DeJuhasz[a] at Pennsylvania State College, in his development of a graphical method of analysis of transient phenomena in linear flow, represented the relation between pressure change and velocity change in the wave front by lines at a constant slope such that

$$\tan \alpha = \frac{k}{a}$$

where k is the constant for modulus of elasticity and a the speed of sound for the medium involved. For fuel oil, tan α is approximately 60.

Professor DeJuhasz also represented the relation between pressure change and velocity change of a swinger or mass in the system in a given time interval by lines at a constant slope such that

$$\tan \gamma = \frac{M}{A \Delta t}$$

If the mass M of the check is represented as the product of its cross-sectional area A, its length L, and unit mass of steel p, and the increment of time, Δt, is taken as the time in which a pressure wave in the fuel oil could travel the length of the check at the velocity of sound in oil, then

$$\tan \gamma = 12\ ap$$

in which a is given as feet per second, and p is mass per cubic inch. For fuel oil and a steel check, tan γ is approximately 560.

This analysis indicates that to produce an equal velocity for a steel part, and for a volume of oil of the same dimensions in the time necessary for sound to travel the length of the oil volume, over nine times as high a pressure must act on the steel as on the oil.

As the ratio of force requirements obtained from this analysis proves to be the ratio of densities of steel and oil, the action of the oil in a system can be considered as obeying the basic law that "force equals mass times acceleration." Each pressure change accelerated a mass of oil for the time necessary for a sound wave to travel the length of the oil mass.

An equal force applied to a mass of steel and a column of oil of equal mass over nine times the volume —will produce the same velocity in both masses in the time necessary for sound to travel the length of the oil column. As a practical application of this interpretation of relative action of steel and oil volumes, the action of a skirted pump-discharge-check may be compared to that of fuel in a length of high-pressure injection pipe. During the period before the check skirt clears its cylinder, a check roughly 5 mm. in diameter and 20 mm. long will have the lag characteristics of fuel oil in a line 70 in. long by 1/16 in. inside diameter.

The effective mass of the check return spring must be added to the mass that must be moved by pressure on the check. Also, the spring in being compressed is, as Professor DeJuhasz has pointed out, equivalent to the addition of a volume of oil behind the check that must be compressed as the check moves.

At low speeds, a moderate pressure may be sufficient to accelerate the check to sufficient velocity to accommodate the displacement of the pump until the skirt clears its cylinder. At higher speeds, higher pressures are necessary to attain the higher check velocities necessary to accommodate the pump displacement. To develop these higher pressures the check must lag more in terms of pump plunger travel. This tendency towards increased lag with increase in speed has been minimized by allowing no more space between the plunger and check than absolutely necessary. In operation of the entire system, the effect of check lag is partially counteracted at high speeds, as the higher pressures behind the check cause a more rapid pressure rise in the line once the check finally opens. To take fullest advantage of this more sudden pressure rise on opening of the check, the volume of the pump bonnet around the spring has been made a minimum.

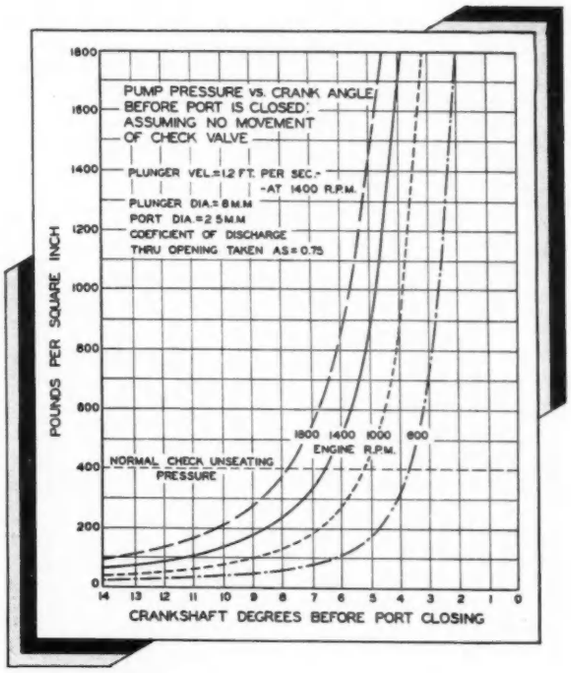


Fig. 6—Calculated fuel-oil-pressure rise due to throttling action of a closing by-pass port.

Fig. 7 is a graph of data taken to show the effect of the check on the lag of a system. The solid line shows injection-system lag vs. engine rpm. for a system with a skirted check. The broken line is for the same system employing no check. The check lag is evident.

Injection System Stability

Under nearly all operating conditions, the action of a skirted check in closing displaces very nearly the

volume of fuel that will be needed at the start of the next cycle to bring the pressure in the system back up to injection pressures. The only serious exception to this rule occurs at low speeds under idling or near-idling loads. Then the combined action of the injector valve and check may conspire to produce a "skip." The "skip" cycle can be explained like this: During one injection cycle, the check compresses the volume in the system to high enough pressure to give the injector needle an upward velocity. Because the effective plunger stroke is short, the scroll bypasses while the needle in the injector still has upward velocity. The check skirt cuts off influx of oil to the line, but oil continues to escape from the nozzle until the injection needle changes direction of travel and seats. Thus, more oil is ejected than is let into the system by the check. As the check skirt retracts, it pulls a lower residual pressure than was present at the start of the cycle. During the next cycle, the check has to move farther before the pressure is built up to valve-opening pressure. During this cycle, more oil is pumped into the line, but less out of the injector. Skip may take the form of alternately large and small injection quantities, or the injection valve may not open at all every other time. Such a cycle naturally results in rough and uneven engine operation.

A system which operates in this manner is unstable and may be stabilized for any given set of conditions by some slight change, such as a change in the length of check skirt or fuel-injection line. To stabilize a system over the entire operating range, however, has required extensive experimentation to determine the correct volume of oil around the check and needle and to obtain rapid needle response.

The effect of length of injection line or pipe on delay in pressure rise is well understood to be a lag of constant time duration. This lag becomes serious only if quite long lines are necessary on a high-speed engine. It has often been found desirable not to use the shortest possible line in every case, as the frequency of pressure-wave travel through one line length might work to advantage, whereas those through a slightly shorter line might not. For this reason, as well as to assure the same timing of all cylinders, the same length of line to all injectors has been found advisable.

The last factor in timing is the injection valve. As

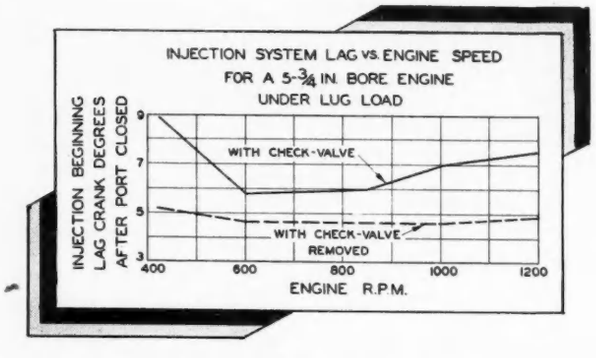


Fig. 7—Effect of a skirted pump-discharge check valve on injection-system timing.

with the check, its parts have a high inertia and add the equivalent to an additional volume of oil behind the needle that must be compressed to open the valve. Time is required for this valve to open sufficiently to accommodate the discharge of the pump. Again it has been found that, although the time required for opening at high speeds is shorter than the time required at low speeds, still the lag in terms of crank degrees is greater at high speeds.

Fig. 8 is a cross-sectional view of the type of differential valve that has been found to give very short

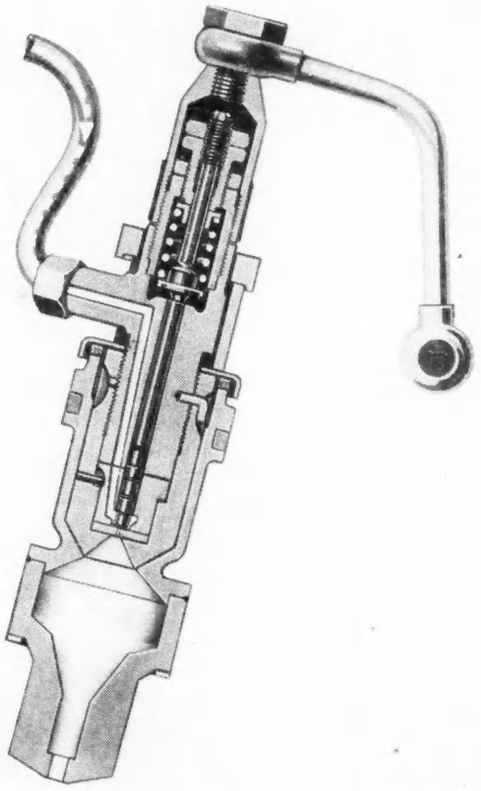


Fig. 8—Cross-sectional view of a Caterpillar fuel-injection valve.

lag. Because the seat is flat, very little lift provides considerable flow area. A previously used pintle valve capable of handling the same rates of flow required a lift of several thousandths before any fuel could flow and full lift was set at ten and one-half thousandths. The present valve allows full discharge with a maximum lift of seven thousandths, and fuel can start flowing with the first movement of the needle. In comparison with a single-hole valve having a conical seat, the flat seat allows use of a smaller seating area with the same spring pressure without increasing theoretical unit seating pressures. In actual practice, due to greater ease in maintaining accurate alinement of seating surfaces, the calculated unit pressures can be increased over those allowable with a conical seating unit. The small seat area results in less needle restraint by oil-film adhesion on opening, and quicker displacement of oil from under the seat on closing.

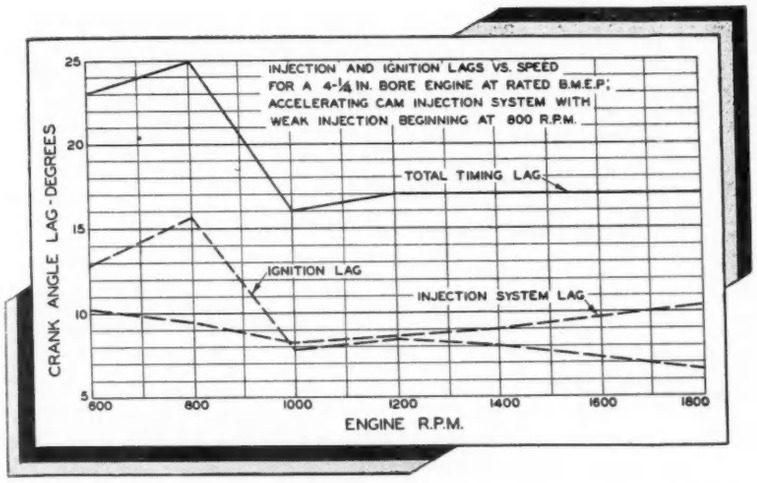


Fig. 9—Timing changes caused by use of an unhappy combination of injection-system parts including an injection-pump cam which produced constantly accelerating motion.

Injection Beginning

Not only must the valve open rapidly to flow, but the pressure behind the orifice after upward displacement of the needle must be sufficient to produce substantial flow. If the pressure surge that started upward motion of the check should be largely spent in displacing the needle, little oil would be forced through the orifice, and the needle would return to its seat. This small quantity of oil might not be sufficient to cause more than a very slight pressure rise in the pre-chamber, with the result that the effective timing would be late. Plunger-accelerating cams, sometimes desired for certain performance characteristics, are serious offenders in this regard at intermediate speeds. An experimental system of this type operated with lags is shown in Fig. 9. Here, lag in crank-angle degrees has been plotted against engine speed for 4¼ by 5½-in. engine, lugged down from rated speed at rated bmep. The easiest way to correct such timing irregularities is to use a constant-velocity-producing cam, but if an accelerating cam is desired, the weights of moving parts in the system and the line length have to be juggled until a cure is found. Fig. 10 shows a series of needle-lift curves, the first of which is that of the offending system at 800 rpm. This first diagram can be interpreted as showing that two slight injections of a pilot nature preceded full-rate discharge. The next four diagrams are included to show the effect of line length on needle action in an otherwise-unchanged system. It is interesting to note that little variation in time of injection beginning was found between 16½ and 34½ in. line systems, but the nature of first opening varied considerably. The last diagram shows the cure effected by using a 26½-in. line, lightening the check and spring, and decreasing volumes in the pump bonnet and valve.

Needle-lift diagrams have been very valuable aids to injection-system analysis. In development of injection equipment at Caterpillar Tractor Co., the study of needle-lift diagrams has supplanted the study of discharge distribution by means of stroboscopic fuel-discharge-collecting apparatus. Early work with needle-lift curves substantiated the belief that the discharge rate must vary almost directly with the lift of needle from its seat, if the valve is of the type having major flow restriction at the needle seat rather than at the orifice. The curves of Fig. 13 show a comparison between needle lift and valve discharge for a standard 4¼ by 5½-in. engine system at several load and speed settings.

The two diagrams for the system at 600 rpm idle bring out an additional advantage of needle-lift study. As each discharge curve valve is an average of twenty-five amounts of fuel collected during one degree of the injection cycles, cyclic variations do not show up. The needle-lift study, however, shows cyclic variations due to the "skip" phenomena previously mentioned.

Control of Injection Rates

An injection controlled for proper timing must continue in such a manner as to produce a highly efficient burning cycle. The second question for which answers have been sought has required knowledge of certain combustion characteristics of the pre-combustion chamber Diesel. The operating cycle of the system is well known. Pressure rise in the pre-chamber due to burning of part of the spray serves to force unburned fuel, mixed turbulently with gases, into the main chamber. Main-chamber combustion, therefore, closely resembles that of air-injection engines. Com-

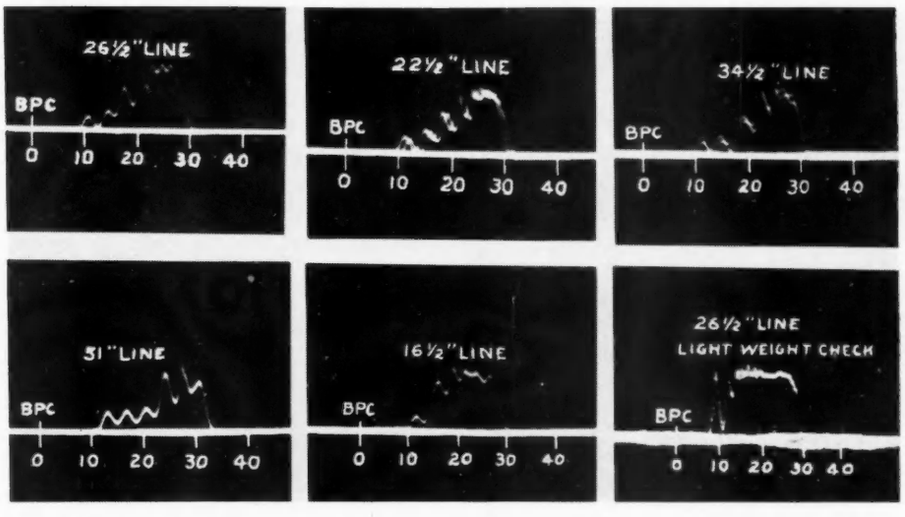


Fig. 10—Needle lift diagrams for systems using a plunger accelerating cam (timing in crankshaft degrees) 800 rpm. engine speed.

bustion in the pre-chamber accounts directly for a portion of the main-chamber pressure rise, as the flow from it shoots into the hollow of the piston. The major main-chamber pressure rise results from the completion of combustion with the oxygen there. The proportion of main-chamber pressure rise attributable to pre-chamber burning has been found difficult to determine, and it no doubt varies widely during the combustion cycle and at different loads and speeds.

A very high rate of pressure rise has been considered undesirable, as it produces high shock loads on bearings, shortening engine life, and results in excessively noisy operation. Still, a high maximum pressure at the end of a short combustion period has been accepted as desirable from a thermodynamic standpoint. It follows that the greater the share of combustion that can be caused to take place with a practically constant, but not excessive rate of pressure rise, the better will be the operating economy. "Caterpillar" experience, in general, bears out this hypothesis.

The problem is to so control the spray characteristics that the beneficial low rate of pressure rise that is characteristic of a pre-chamber system will not be lost, and at the same time to continue the pressure rise to as near the end of the combustion phase of the power stroke as is possible. To maintain a given rate of pressure rise when the piston is accelerating downward requires a combustion process that burns the fuel at a rapidly accelerating rate to almost the end of the combustion cycle.

Two characteristics of the injection system exert considerable control over the combustion cycle. The first is the rate of injection, mainly controlled by the injector restriction and the cam profile, and the second is the character of the fuel spray. A cam that accelerates the plunger as injection progresses would seem desirable, as it would produce higher injection rates as the cycle progresses. With certain sizes and shapes of combustion systems, a slight advantage in an accelerating cam has been found. With other engines, the difficulties in controlling timing that are introduced by such a cam have outweighed any slight advantage evident.

As has been pointed out, timing problems tend to be more acute with an accelerating plunger system, but if sufficient performance gain is obtainable over other systems for a certain size of engine, solution of the timing problems is well in order. However, an injection system using a constant-velocity cam may produce a spray character that seems to control the combustion cycle of another size of engine so well that no definite improvement can be obtained by changing to an accelerating cam.

This introduces the subject of spray formations and their evident effect on engine performance. It is general knowledge that a very-high-velocity, finely atomized spray is not necessary with a pre-chamber combustion system. The first injector valves built by "Caterpillar" were of the pintle type, which produced a hollow spray with an 18-deg. included angle spray. This spray penetrated about 5.7 in. in 0.002 sec. in open air, and not over 9 in. during 0.006 sec., a time equivalent to full injection duration at 850 r.p.m. Fig. 11 is a photograph made during a light flash lasting one-millionth of a second. It was taken of the spray from such a pintle nozzle spraying into open air, and shows the spray just at the end of a full-load injection for a 5¾ by 8-in. engine at 850 rpm. Quite a dense mist of atomized spray was formed. Such a system, used with a properly chosen pre-combustion chamber shape, performed quite satisfactorily at the moderate bmep and speeds demanded of the first Diesels "Caterpillar" produced.

The endeavor in the improvement of any engine, of course, has been to improve efficiency and to increase the output of a given cylinder size, by increasing both bmep and top speeds. The performance of this type of Diesel was definitely improved by changing to a straight-orifice valve. Contrary to what might be expected, the ignition lag was shortened by the change, and exhaust gases were cooler and clearer under all

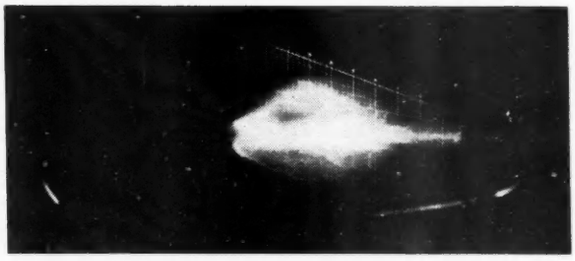


Fig. 11—High-speed photograph of pintle-type fuel valve injecting into atmosphere. 18 deg. angle pintle valve spray; 5¾-in. bore engine injector, old style.

operating conditions. More fuel, therefore, could be burned in the same engine without increasing the specific fuel consumption, and better economies could be obtained under rated loads when compared to operation using a pintle valve.

The spray from the valve which replaced the pintle valve has an envelope of mist that spreads from the concentrated core at an included angle of 16 deg. immediately on leaving the orifice. The center core is narrow and penetrating, and does not entirely break up until after considerable penetration. Fig. 12 is the spray from such a valve. It penetrated 8.7 in. in 0.002 sec. in open air, or one and one-half times as far as the spray of the pintle valve. After 0.006 sec. it penetrated 24 in., two and two-thirds as far as did the pintle-valve spray.

Since in the pre-chamber system of combustion, energy of burning in the pre-chamber is utilized to eject a gaseous, fuel-rich mixture into the main chamber, burning can be accelerated, thereby increasing flow through the burner tube as the cycle progresses, if a major share of the pre-chamber air is left to be burned with the last of the fuel injected. A combination of pre-chamber shape and spray characteristics such that the first of the pressure rise is largely due to burning in the main chamber, leaves a good supply of air to promote rapid combustion of the last of the fuel injected. With a penetrating spray system, com-

bustion is likely to begin near the lower end of the burner tube after the light mist surrounding the heavy core has been heated and vaporized. This mist provides just sufficient burning to maintain the turbulent flow of mixture to the main chamber and to compress and heat the unused air in the upper, larger part of the pre-chamber. This supply of hot, unused air serves to increase the rate of burning as the injection cycle progresses. In this manner the simple orifice, high-penetration valve seems to function to produce high, efficient engine output.

A consideration of a cross-section of the fuel injector now used shows the orifice that develops high penetration. The length-to-diameter ratio is between 5:1 and 7:1, depending on the orifice diameter. The volume of oil in the nozzle, the differential areas of the needle, and the rate of flow all affect penetration; and, so far, experimentation has been necessary to determine the best combination in each case. Nozzle volumes and needle dimensions that have led to increase in penetration have also proved to be most effective in obtaining a strong injection beginning. Good timing and good penetration have been found to go hand in hand with this type of valve.

In obtaining the desired characteristics in units in the research laboratory, attention had to be given to the questions: First, can the critical dimensions and specifications be easily and accurately duplicated by the processes of mass-production manufacture; and, second, will the desired characteristics be maintained reasonably well during the service life of the parts.

The greater ease of obtaining a good seat for the needle of the injection valve shown in Fig. 8 has been pointed out already. The fact that the orifice is in a separate plate provides ease in controlling orifice length and shape, and it also facilitates reconditioning or replacing of a flame plate without relapping the needle to the nozzle. Another feature is found in the fact that the direction of spray propagation is controlled by the orifice alone; slight eccentrics of a needle or pintle do not cause a lopsided spray formation.

This same flat-seat principle has been applied to the design of the skirted check-valve. With such a design, a good seat is more easily obtained, as concentricity of seat to lapped diameter does not have to be maintained.

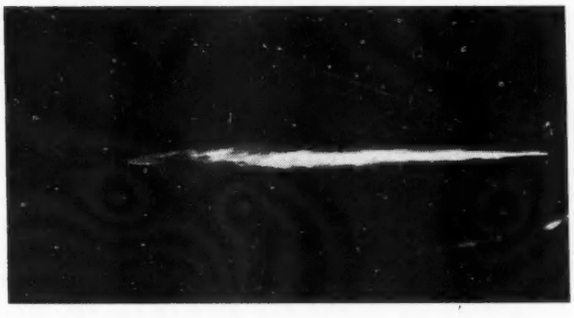


Fig. 12—High-speed photograph of single-hole orifice fuel valve injecting into atmosphere. Diameter of orifice 0.025 in.; length 0.120 in.; bore of engine injector 5¾ in.

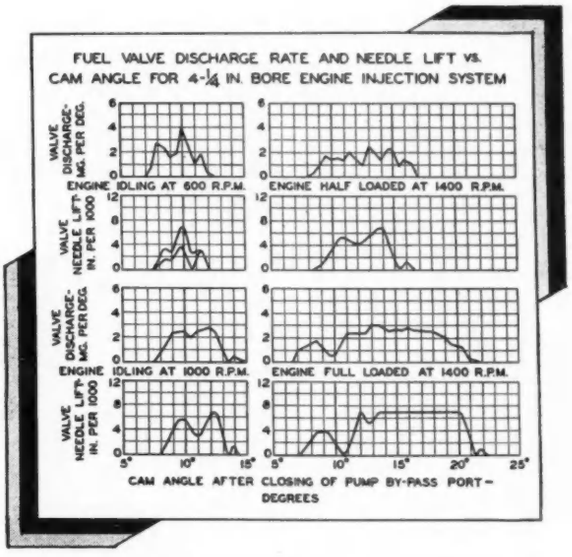


Fig. 13—Curve showing extent of correlation between the lift of the injection-valve needle and the rate of fuel discharge for different engine loads and speeds.

Conclusion

Many tests have been conducted, and a few changes made in injection-equipment design to better fit a system to the requirements of a pre-combustion chamber Diesel engine. The hydraulics and mechanics of injection systems involve so many factors that a remarkable range of characteristics is obtainable. Only a few systems have been extensively studied and developed by builders of injection equipment for the express purpose of obtaining maximum performance from one type of engine. Exchange of information gained from many such studies would bring a valuable increase in practical knowledge of methods of injection-phenomena control. A profitable study has been made for one type of pre-combustion chamber, high-speed Diesel. The development has led to a design of injection system that has a proper combination of factors for controlling the combustion of that engine.

Reference:

(1) "Graphical Analysis of Transient Phenomena in Linear Flow," by Kalman J. DeJuhasz, *Journal of the Franklin Institute*, Vol. 223, April, 1937, pp. 463-493; May, 1937, pp. 643-654; June, 1937, pp. 751-778.

Auto Finish

Recent check indicates that synthetic resin finishes have made considerable headway in the automotive industry. For example, all Chrysler Corp. cars; Ford, Mercury, Lincoln-Zephyr; Nash, Willys, and Studebaker Champion—are finished in synthetic materials. In addition, the synthetic finishes have proved admirably economical for commercial and motor truck bodies and cabs. In the comparatively short space of time in which synthetic finishes have been available to the trade they have met a rather wide acceptance.

MEN and MACHINES • • •

THE HORIZONTAL "Z-model" gear shaper which was announced recently by the Fellows Gear Shaper Co., Springfield, Vt., is an interesting departure from the regular line of equipment built by this company. The machine is particularly suited to the machining of gears or clutches that are integral with long shafts, such as the aeroplane engine crankshaft set up on the unit illustrated herewith.

The work spindle on this machine is mounted in a slide which is adjustable along the base for positioning the work relative to the cutter. The slide also carries a bracket which retains a swinging shoe that supplies additional support for the work. This shoe can be lowered to remove and insert the work. The work is held in an adapter retained in the work spindle, the latter having an 18-in. diameter straight hole.

The cutter spindle, which is of the "relieving type," is held in the head slide, the latter being adjustable along the base in a direction at right angles to the work slide. Movement of the slide controls the diameter setting of the cutter with relation to the work.

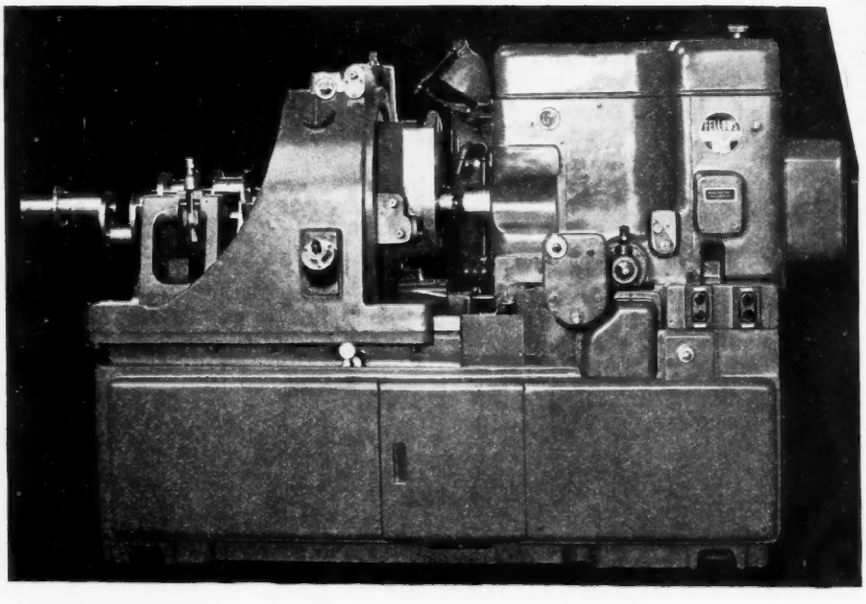
Maximum capacities are: Movement of work slide, 19 in.; movement of cutter slide for external gears, 6½ in.—for internal gears, 2 in.

FELLOWS also has developed a flame hardening machine for local hardening of gear teeth and other parts. The work to be hardened is held on a stub arbor, or between centers, depending upon the shape and character of the work. Work is driven from the headstock spindle, the latter being rotated through an adjustable speed "texrope" drive from a motor, and giving a speed range from about 125 to 800 r.p.m. Treadles located at both ends of the machine operate an ejector for removing the work from the stub arbor, and a transfer device immerses the work in the quenching medium.

Six torches surround the work, each torch having a number of nozzles. The torch equipment is carried on a saddle that is mounted on, and is moved along two brass pipe supports, permitting the torches to be located in the desired relation to the work. Maximum capacities of the machine are: 12-in. diameter, 2-in. face, and shaft lengths up to 36 in.

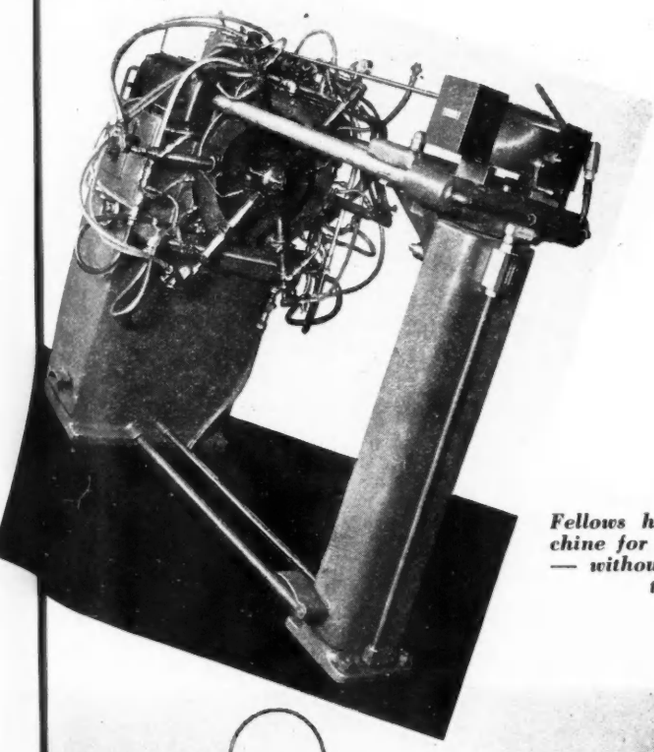
ABILITY to gas cut straight lines, rectangles, circles and irregular shapes from ferrous metal of any thickness within present practical limits of the cutting torch is claimed for the new Airco No. 10 Planograph

Fellows horizontal "Z-model" gear shaper for cutting gears and clutches on long integral shafts.

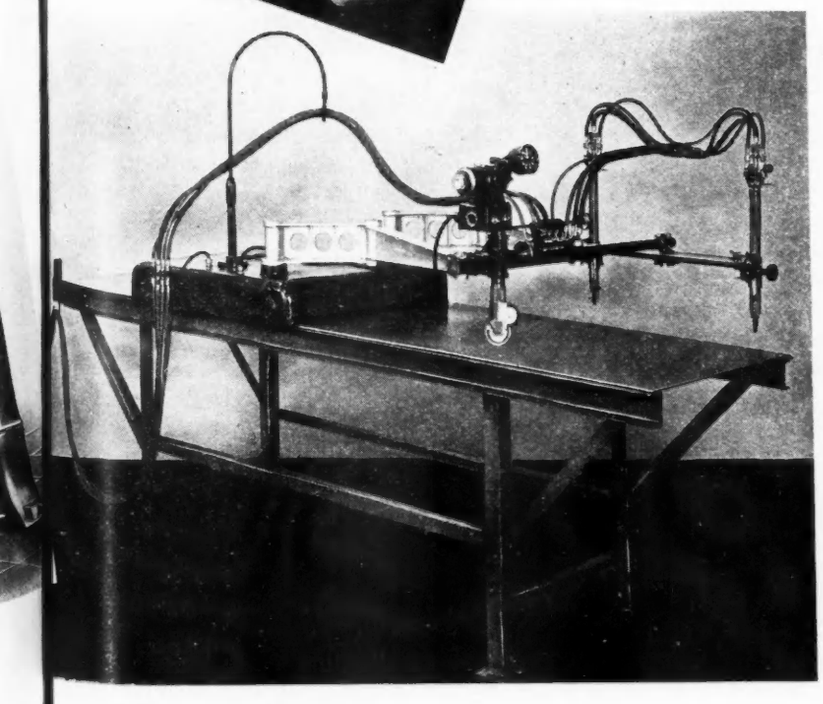


Newest enclosed press of the four eccentric type built by E. W. Bliss Co. Rated capacity is 750 tons.

New equipment is constantly being developed to expedite production. This regular feature keeps you informed.



Fellows hardening machine for heating gears — without quenching tank.



The Air Reduction Sales Co.'s new No. 10 Planograph.

announced by Air Reduction Sales Co., New York. The planograph consists of a tracing table upon which the carriage travels. Torches and tracing devices are supported on the carriage.

Cutting range of the No. 10 in single torch operation is 24 in. wide by 72 in. long. This length can be increased indefinitely in multiples of 72 in. by utilizing additional tracing tables. The maximum diameter of circle cuts is 24 in. When two torches, mounted on the regular operating bar, are employed for simultaneous cutting, the cutting area for each torch is 12 in. wide by 72 in. long. Two circles each up to 12-in. diameter also can be cut with the torches mounted in this manner. By using an auxiliary bar, the cutting area of each is 24 in. by 24 in.

A tracing device for manual tracing on this machine can be locked so that it will, without manual guiding, travel in a straight line in any desired direction. Devices for magnetic and templet tracing can be quickly interchanged in the existing head. Speed of the motor is governed by a graduated disk known as the Index Speed Control. This disk provides a complete range of motor speed in one full turn of 360 deg. Cutting speed in inches per minute is registered on a reversible tachometer.

NEWEST enclosed press built by E. W. Bliss Co. is of the four eccentric type, the slide being actuated by a connection to each corner which is, in turn, driven by an eccentric. Eccentric shafts run front to back with main bearings mounted in heavy crown ribs, distributing the thrust loads throughout the crown. The press is double geared with herringbone steel gearing throughout the main drive, twin driving gears on the crankshafts, and all gears running in a bath of oil.

The clutch is operated by electric push button control. The flywheel is mounted on the Timken roller bearings and can be

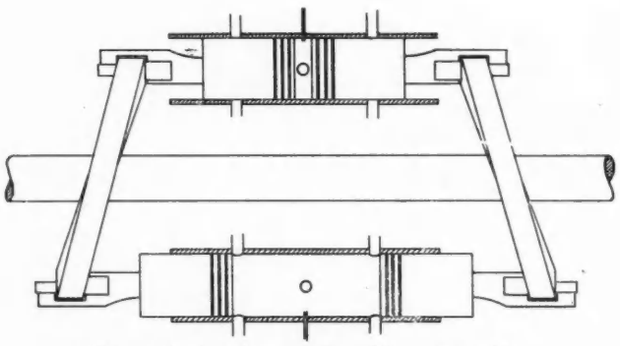
(*Turn to page* 610, *please*)

Barrel-Type Engine Is Tested

REPEATED reference has been made in these columns to the Alfaro barrel-type engine, which has been under development by Aircraft Development, Inc., Boston, Mass., with the assistance of the Bureau of Air Commerce (now the Civil Aeronautics Authority). It passed its contract 2-hour acceptance test nearly a year ago, and a report on this test, by K. S. Cullom of the Power Plant Section, Civil Aeronautics Authority, was issued recently.

The engine is of the crankless type, employing two cam plates which are actuated by double opposed pistons, and operates on the two-stroke cycle, with fuel injection and spark ignition. It has four cylinders with a bore of 2 11/16 in. and a stroke of 3⅜ in. per piston, making the displacement 167 cu. in. The cylinders are parallel with the drive shaft and arranged symmetrically around it. The two pistons in each cylinder are arranged with their heads opposing each other, so as to form a common combustion chamber. They act on two cam plates machined integral with the drive shaft, by means of roller bearings. Single-row annular ball bearings support the drive shaft.

Intake and exhaust are through ports in the cylinder wall which are controlled by the pistons —the intake ports by one and the exhaust ports by the other piston in the same cylinder. Fuel is injected under a pressure of 2000 lb. per sq. in. by means of a pump comprising two Bosch units placed at right angles to each other, on a cam casing which also contains a drive for the fuel transfer pump and the tachometer. An adjustable coupling in the camshaft drive permits of accurate timing of the injection.



Schematic drawing of the Alfaro barrel-type aviation engine

Scavenging air is supplied by a centrifugal blower built with the engine and driven by gearing at approximately ten times crankshaft speed. Measurements showed that at an engine speed of 2000 r.p.m. and a delivery of 350 cu. ft. of free air per minute, under a pressure of 6.5 in. of mercury, the blower consumes 8.34 hp., which makes its adiabatic efficiency approximately 60 per cent.

During the tests, ignition was supplied by two special 12-volt Auto-Lite coils and Champion 14-mm. spark plugs. The generator is driven by a belt from the end of the camshaft, and an Eclipse-type electric starter is fitted.

Lubrication is by the dry-sump system. Oil is sprayed through jets onto the cam plates, while the reciprocating parts are lubricated by oil scooped from these elements.

The compression ratio is 9.5:1. Including the starter and generator, which together weigh 29 lb., the engine in the dry condition weighs 269 lb. Its over-all length is 44 9/16 in. and its body diameter approximately 15½ in., excluding spark plugs and other small protruding accessories.

In the tests, which were made on 87 octane fuel, the engine developed 113 b.hp. at 2030 r.p.m., which corresponds to 132 lb. per sq. in. b.m.e.p., and it consumed 0.59 lb. of fuel per b.hp.-hr. Observed values were: Corrected to standard conditions the output was 115 hp. at 2000 r.p.m. and the b.m.e.p. 136 lb. per sq. in.

The tear-down inspection made after the test showed a broken Oldham coupling disc in the fuel-pump drive and one slightly fractured crosshead casting The dry specific weight of the engine (2.34 lb. per hp). is about the same as that of radial air-cooled engines of the same power. The cooling system would add between 0.4 and 0.5 lb. per hp. to the specific weight, hence the engine in working condition is somewhat heavier than a radial air-cooled engine. Mr. Cullom states, however, that the weight of this first engine can be reduced considerably by refinement of design, because the cylinder block including the water jacket is made of cast iron. It has been estimated by the designer that an eight-cylinder type of the same bore and stroke would deliver approximately 265 hp. at 2400 r.p.m. with a total weight, including the ethylene-glycol cooling system, generator and starter, of close to 400 lb., which would give an estimated total specific weight of 1.5 lb. per b.hp. The diameter of the main body of the engine would remain 15½ in.

The frontal diameter of the engine is close to one-half that of equivalent radial engines, so that the frontal area is about one-fourth as great. This factor would prove a considerable advantage in minimizing powerplant drag at high speeds, in addition to improving the visibility from single-engined aircraft. The engine embodies the important feature of two-cycle operation, which in the author's opinion is essential to large reductions in specific weight. It also lends itself to the use of compression ignition and of heavier fuels.

PRODUCTION LINES . . . .

On Lubes

We suspect that oilmen will have some problems in lubrication this coming season. For one thing there is the matter of hypoid gear lubes. Much educational effort still is needed to assure the proper lubrication of passenger car and truck hypoids. Of course the problem will vanish if and when one of the specialists succeeds in producing what may be termed a universal material. We hear, too, that one of the new running gear units to be introduced will impose very precise specifications on its lubricant. By the very nature of its hydraulic system, this unit requires absolute stability and freedom from oxidation. This will introduce still another variable in the chassis lubrication picture.

Re Mufflers

Corrosion bitten mufflers still constitute one of the most active items in the replacement field and, incidentally, a sore spot to the motorist. Suppose it were possible to coat muffler sheet metal with a synthetic heat and corrosion resistant paint, we were asked by one who has produced such a material. It is claimed that the paint is not expensive and would not add to the cost of a muffler. We think that it's an idea worth exploring and would be glad to place you in touch with our informant.

Wood Base

With plastics so widely discussed these days, it was of interest to learn that the U. S. Forestry experiment station has developed a special plastic formula incorporating a wood base extracted from ordinary shavings. It is claimed that this plastic has acceptable physical and dielectric properties and has the advantage of reasonably low cost. Unique feature of the material is the ability of making large plastic panels with a facing of natural wood veneer, marking a rather interesting application for instrument panels, garnish molding, etc. Normally the plastic is black and, consequently, of use only in places where utility is the objective. More on this subject sometime later.

By Committee

You have heard us talk off and on about the committee action that takes place behind the scenes in automotive organizations worthy of a place in modern industry. We are talking now about the fact that groups of varying size, rather than individuals, determine engineering design, merchandising policies, buying, and a lot of other activities. Our interest in developments in this direction has been whetted by an organization chart that came through the mails from our friend Fred M. Young, president of the Young Radiator Co. It's the first chart of its kind we have seen in recent years. In addition to the familiar arrangement of management functions of executives, the chart gives each executive a key number, lists the principal functional committees, indicates the key numbers participating in each group. We offer this chart as a prize exhibit in management literature.

Vetoes Practice

Development of far reaching importance in the plastics field is on the eve of announcement. As is well known, injection molding has been widely used and has cut production time to but a fraction of former practice. However, up to the present time the process has not worked with phenolic resins and, in general, with resins of thermo-setting type. We understand that a special type of injection molding machine has been developed specifically for phenolic and urea plastics. It has been demonstrated experimentally for almost a year and now is ready for exploitation. Its use is said to reduce molding time to but a fraction of the best time known to the art—and we get this not from the inventor but from one of the cooperating plastics producers.

No Rust

Valuable contribution to factory management is a comprehensive discussion of rust prevention by the use of slushing materials in the September issue of *Lubrication*. The article describes the various types of rust formations found on stored machined parts and sheet steel, touches on the conditions which contribute to rusting, discusses the functions of a slushing oil. A number of different types of rust-preventing oils are considered, including special rust-proofing materials, the presentation closing with a discussion of methods of removing such coatings after they have served their purpose. We urge you to get a copy of this article without fail.—J. G.

Chrome Plating Cylinder Bores

(*Continued from page* 579)

aluminum pistons than in those with iron pistons, which may be due to the fact that oil adheres better to cast iron than to aluminum.

In efforts to overcame this scoring trouble, Mr. Van Der Horst, in collaboration with engineers of the Shell Petroleum Company in London, tried out seven different lubricants. Only one of these gave satisfactory results, but that was a blend of mineral and animal oils, and since such blends are not carried by service stations it would hardly have been a commercial solution of the problem. It was found that all of the British light and moderate-sized cars will score if their cylinder bores have a coating of bright chromium applied, so this type of coating is not a commercial proposition.

The problem was solved by the development of a type of coating which is said to be porous and to look very much like an open-grain cast iron. Any ordinary type of cylinder oil can be used with such a coating. Such an open-grain chromium bore is finished by a light honing, which is said to take only about a minute per bore. The cylinder wall then has a grayish appearance, and the structure is such that an engineer might hesitate to run a piston in it, but practice is said to have shown that it is the best. One British manufacturing concern specializing on Diesel engines running at between 1700 and 2000 r.p.m claims that it gets 5 per cent more output from its engines since it adopted chromium plating of the bores as standard practice. A gain of 5 per cent seems a lot, but Mr. Van Der Horst points out that the appreciable reduction in piston-ring and ring-groove wear observed by various investigators points to the conclusion that there must be much less friction.

The open-grain chromium coating has a big advantage from the production standpoint, for a bore having such a coating can be honed to size much easier than one having a coating of dense chromium. In fact, with a coating of dense chromium, if the bore does not turn out correct to within one one-thousandth inch minus, the finishing operation takes an excessively long time and is therefore relatively expensive.

Now, the same as in practically all machining operations, a tolerance is required on the bore of a chromium-plated cylinder. The job cannot be done dead accurate commercially. With a porous open-grained coating, excess metal to the extent of from one-half to one-thousandth can be easily removed by honing. Naturally, the bore should not turn out to be "plus," because if it does not pass the inspection, the only way to salvage the block or liner consists in stripping the chromium and plating the unit over again. After stripping, the bore should always be honed.

Considerable equipment is necessary to chromium-plate cylinder bores on a production basis. The amount of chromium that must be deposited is from 200 to 500 times as much as needed for the same area in plating for decorative purposes, and there is no getting away from the fact that the consumption of electrical energy is very much greater than in other forms of chromium plating. The cost of the motor generators which produce the low-tension direct current needed for plating is by far the most important factor in the set-up required.

As regards the effect of a coating of coarse-grained chromium in reducing bore wear and piston-ring wear, we quote the following from the "Fourth Interim Report of the Automobile Research Committee on Cylinder Wear," by C. G. Williams, M.Sc.:

"As part of a program of tests on cylinder and piston ring materials, experiments have been carried out on a water-cooled cylinder barrel chromium-plated commercially. The operating cycle involved 5 min. idling, 10 min. under power, followed by 15 min. cooling, the normal amount of lubricant being supplied to the cylinder bore. * * *

"The rate of wear was first determined on a plain cast-iron cylinder of 241 Vickers Brinell hardness, the composition of the iron being 3.55 per cent C, 0.83 per cent CC, 0.90 per cent Mn, 0.53 per cent P, 1.2 per cent Si. The chromium-plated barrel was then substituted and the tests continued, using the same piston and rings, under the same conditions. The individual wear figures are shown plotted, in the graph shown here, against the number of cycles for both cylinder and top piston ring. The rate of wear of the plain cylinder, determined from this graph, was 0.00022 in. per 1000 miles—a fairly normal rate of wear. The cylinder wear on the chromium-plated barrel was very low and only a very rough idea of its magnitude can be given, viz., 0.00003 in. per 1000 miles. These cylinder wear rates for the plain and chromium-plated bore are in the ratio of about 7:1. It is of interest to note, also, that the top piston ring wear with the plain cylinder was 0.00252 in. per 1000 miles, while with the chromium-plated barrel it was 0.00058 in. per 1000 miles, i. e., in the ratio of about 4:1. Thus, the chromium plating effected not only a very large reduction in cylinder wear, but also a large reduction in the wear of the top piston ring."

Proposed Standard for Tractor Distillate

THE successor to the Paris General Omnibus Company, which operates all means of public transport in the department of the Seine, has petitioned the government to postpone the application of the decree which compels all public transport companies to operate 10 per cent of their vehicles on native fuels after Jan. 1, 1940. It is understood that the company for a long time has been conducting trials with suction gas produced from wood, but that the results have been very unsatisfactory. The company operates a total of 3700 buses, and 370 would have to be run on native fuels. As an alternative to buses using suction gas produced from wood, it has been proposed to run trolley buses in the outlying districts and buses running on compressed coal gas carried in steel bottles in the city, but this proposal is not in conformity with the spirit of the decree, which aims at the utilization of forest products in commercial vehicles.

NEWS OF THE INDUSTRY

U. S. Registrations Set New Record. See page 595

Jouett Sees Fewer Errors

Aircraft Industry Will Avoid Overproduction

American aircraft production capacity today is about 15,000 units a year, and aircraft engine capacity is more than 16,000 units annually, according to Col. John H. Jouett, president, Aeronautical Chamber of Commerce of America, Inc. By the end of 1940, he predicted, the nation's aircraft capacity will be 25,000 units annually, and engine builders will be able to produce power plants at a still larger rate per year.

Speaking before the Greater New York Chapter of the National Aeronautic Association, Colonel Jouett said that the aeronautical industry "will not repeat the over-expansion and excess-profit mistakes of the 1918 and 1919 period."

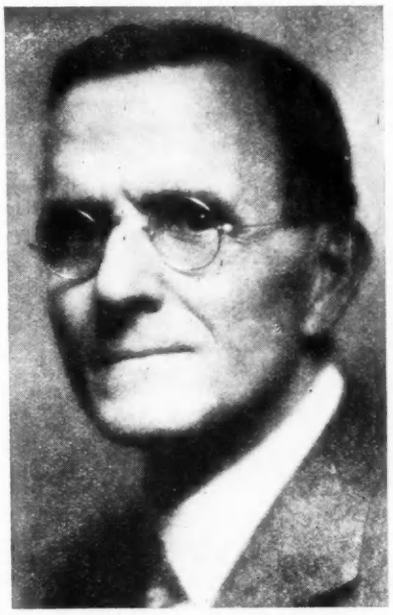
He estimated that with the close of the World War more than $100,000,000 worth of contracts had been canceled in three days, and that 90 per cent of the plant capacity of the whole industry had been liquidated in three months. The paradox of the industry is its far-seeing research and development work on the one hand, and its caution against excessive expenditures and over-expansion on the other.

In 1917, he said, five factories employing about 5000 employees constituted the aircraft industry. Today, he said, 45 plants are employing more than 45,000 people building aircraft.

"Our government orders, contrary to popular impression, have not been profitable to the industry as a whole. On the other hand, the export business of the industry has been profitable, averaging about 10 per cent. This business has been done in the American way—without government subsidy or government ownership which have crippled the industry in foreign lands," he said.

During the five-year period of 1934 to 1938, inclusive, the net profit on all aircraft sales amounted to about 5.4 per cent of sales, he said. During this period American manufacturers had ploughed back 9.4 per cent of the gross sales figure in research and development.

(*Turn to page* 604, *please*)



C. W. Spicer

dies in Miami at 64

Clarence Winfred Spicer, founder of its antecedents and vice-president in charge of engineering of the Spicer Mfg. Corp., Toledo, died Nov. 21 in Miami Beach, Fla., at the age of 64. An active member of the Society of Automotive Engineers for thirty years, he served as president in 1938, and was a veteran and chairman of various committees. He was S.A.E. treasurer in 1931.

An outstanding engineer, inventor of the universal joint that bears his name, organizer of a manufacturing company just a year after completing his mechanical engineering course at Cornell, Mr. Spicer's interest in mechanics was fired by the dairy machinery on the

(*Turn to page* 604, *please*)

Carl Behn

Carl Behn, vice-president of American Bosch Corp., Springfield, Mass., died on Nov. 15 after a brief illness. Mr. Behn joined the American Bosch organization in 1923 and was made vice-president in charge of sales in 1938. He was prominently active in various engineering societies and in 1938 was a vice-president of the Society of Automotive Engineers.

Plans Appeal In GM Decision

"Ghost" Held Guilty Says Counsel Smith

A jury of farmers, small businessmen and retired merchants on Nov. 16, in the federal district court at South Bend, Ind., found General Motors Corp., and three of its affiliated corporations guilty of charges of conspiring to restrain interstate commerce in GM cars by coercing its dealers to use facilities of GMAC. At the same time, 17 individual defendants, including Alfred P. Sloan, Jr., William S. Knudsen and John J. Schumann, Jr., were acquitted.

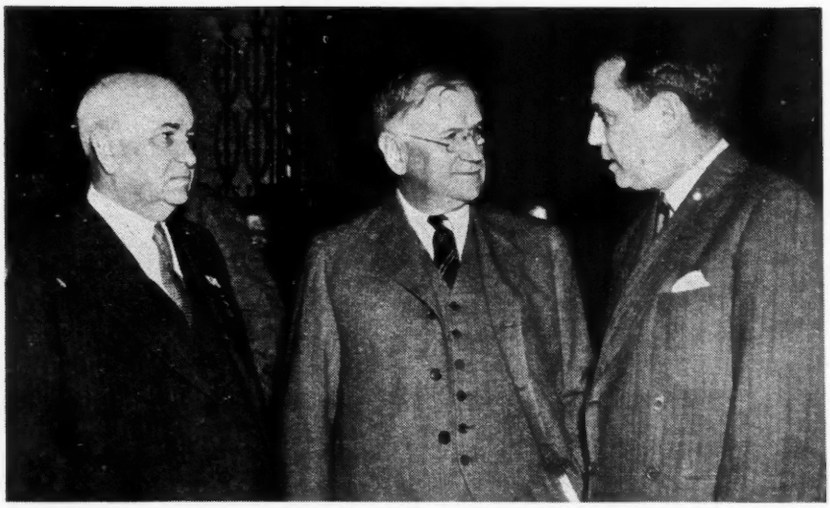
On the following day Judge Walter C. Lindley fined each of the corporate defendants $5,000, the maximum under the Sherman anti-trust law. When Judge Lindley overruled motions by the defense for arrest of judgment and a new trial, John Thomas Smith, chief defense counsel, said an appeal would be taken to the federal court of appeals in Chicago. Enforcement of the judgment was held up, pending the appeal, and each of the four corporations posted bonds of $2,500. Costs of the court action, estimated to be $100,000, were assessed against General Motors and General Motors Sales Corp.

"The government charged conspiracy to restrict interstate commerce," Mr. Smith said in arguing the motion for arrest of judgment, "but the corporations could not conspire. The individuals alone could have conspired and the individuals were acquitted. Acquittal of the individuals has taken the flesh and blood out of the government charges and left only the disembodied spirit of the corporations. The alleged crime has vanished into thin air. The ghosts that are left should not be sentenced."

Judge Lindley, however, in refusing to vacate the verdict, said the jury had the right to acquit the individuals and convict the corporations. The jurors might have felt, he said, that certain of the under-officers of the corporations had gone beyond their capacities in committing the acts charged without consent or knowledge of the executives named in the indictment.

"However, whether a court of a review will sustain the verdict, I don't

(*Turn to page* 598, *please*)



Acme

He'd Use a Tank

Secretary of the Interior Harold L. Ickes (center), in a lively speech before members of the American Automobile Association, said he longed for the time when he can take an armored tank down a "truck infested" highway, "bumping these pests from the road." He is shown here with Thomas P. Henry (left), president of the A.A.A., and Leo Dolan, president of the Inter-American Travel Congress. The occasion of this picture and Mr. Ickes' remarks was the 37th annual convention of the A.A.A. held recently in Washington.

Ickes Scores Trucks on Highways In Talk Before AAA Convention

Secretary of Interior Calls Manufacturers' Use Of Trucks for New Car Delivery "Insolence"

Secretary of the Interior, Harold L. Ickes, in speaking before the 37th annual convention of the American Automobile Association held in Washington, Nov. 15-16-17, vigorously scored truck traffic on our national highways and referred particularly to new-car transports. Opening his speech with reference to the organization of a Federal Travel Bureau to encourage European tourists to visit this country, Mr. Ickes stated that American road manners should be improved if such visitors are to find any pleasure in their stay.

After commenting upon the careless driving habits of the average private car driver and urging that cognizance be taken of the need for minimum as well as maximum speed limits, Mr. Ickes launched a tirade against truck traffic. "I doubt whether anyone will question the fact that the people started to build good roads," said Mr. Ickes, "so that they might have the pleasure and recreation that is made possible by traveling in their own cars at their own pleasure at reasonable rates of speed. At least this has been what we thought we were paying our road taxes for. But now we know better. We know now that we have been digging into our pockets to build boulevards for trucks. The lord of the highway is the truck driver. The monster which he drives at reckless speed regardless, generally speaking, of the rights of the mere motorist, each year seems to be growing longer and wider and higher. And if one truck isn't big enough to satisfy the road appetite of its owner, he can always attach a trailer. Thirty-five years ago we had rough roads; narrow roads that were alternately covered with dust or mud. But at any rate we had no trucks.

"I have promised some day to give myself the pleasure of driving down a truck infested road in the biggest armored tank that I can find and bumping these pests from the road, regardless of where they may light."

Mr. Ickes was particularly emphatic in his remarks concerning new-car transports. "What particularly annoys me on a holiday or week-end trip," said Mr. Ickes, "is to see emerge out of the distance a leviathan that has just had a litter of motor cars that it is transporting from the lying-in factory. This is my pet abomination—not because it has broken out all over with new motor cars, not even because of its unusual width and most extraordinary length, but because it seems to me to be nothing less than insolence on the part of

(*Turn to page* 605, *please*)

September Car Financing Amounted to $94,316,004

Dollar volume of retail automobile financing for September, 1939, amounted to $94,316,004, according to the Bureau of the Census, Department of Commerce. This is a decrease of 19.2 per cent when compared with the previous month, an increase of 40.3 per cent as compared with September a year ago, and a decrease of 27.8 per cent as compared with September, 1937. The volume of wholesale financing for September, 1939, amounted to $65,309,948, an increase of 38.8 per cent when compared with August, 1939, and increase of 129.2 per cent compared with September, 1938, and a decrease of 16 per cent as compared with September, 1937.

Volume of retail automobile receivables outstanding at the end of September, 1939, the Bureau reports, amounted to $848,528,973.

Ethyl to Spend $4,000,000 On Baton Rouge Expansion

Ethyl Gasoline Corp. has announced that it will undertake a $4,000,000 plant expansion program at Baton Rouge, La. A plant for manufacturing tetraethyl lead, processing plants for raw materials including an additional ethyl chloride plant, added capacity for the electrolysis of salt brines to manufacture metallic sodium and chloride gas and other improvements are planned.

The project will require the employment of betweeen 800 and 1000 men for construction, covering a period of about one year, and will be contracted for and done under the supervision of E. I. duPont de Nemours & Co., which company has contracted with Ethyl to operate a substantial portion of the plants at Baton Rouge.

1939 Rim Inspections Top Last Year's Mark by 92.5%

The Tire & Rim Association reports that during October it inspected and approved a total of 1,882,190 rims, an increase of approximately 43.5 per cent over October a year ago. During the first 10 months of 1939 the Association inspected 13,617,858 rims, an increase of approximately 92.5 per cent as compared with the first 10 months of 1938.

Borg Earnings Jump

Borg-Warner and subsidiary companies earned $3,483,036 net for the nine months ending Sept. 30, which compares with a net loss of $1,111,461 for the comparable period of 1938.

Total assets are listed at $47,050,835 in the consolidated balance sheet of the company for the period ending Sept. 30.

40 YEARS AGO

The Keystone M. & M. Co., of Lebanon, Pa., have just completed a steam automobile. The motive power is steam, generated by a small tubular upright boiler of the general shell type used in light vehicles. The application of steam is through small cylinders in the hub of the wheel, each of the rear wheels being supplied with three small engines of that type. The fuel is gasoline generated from a hydro-carbon burner.

The construction of the motors is such that they dispense with the use of sprockets, chains and compensating gears, each wheel being independent of the other on a stationary axle. At a speed of 200 revolutions of the engine the carriage will travel 20 miles an hour.

From The Horseless Age,
December, 1899.

Canada's Output Leaps

Production of automobiles in Canada during October totaled 9,640 units against 3,921 in September and 5,774 or 66.5 per cent over October, 1938. For the ten months ended October the cumulative output of automobiles in Canada numbered 119,926 units against 129,480 in the corresponding period of 1938. Production since the beginning of 1938 and comparative figures follow:

	1939 Units	1938 Units
October	9,640	5,774
September	3,921	6,089
August	3,475	6,452
July	9,135	9,007
June	14,515	14,732
May	15,706	18,115
April	16,891	18,819
March	17,549	16,802
February	14,300	16,065
January	14,794	17,624
	1938 Units	**1937 Units**
January	17,624	19,583
February	16,066	19,707
March	16,882	24,901
April	18,819	17,081
May	18,115	23,458
June	14,732	23,941
July	9,007	17,941
August	6,452	10,742
September	6,089	4,417
October	5,774	8,113
November	17,992	16,574
December	19,670	21,115
Total	168,142	207,465

Douglas Gets the Guggenheim

The Daniel Guggenheim Medal for 1939 has been awarded to Donald Wills Douglas, president of the Douglas Aircraft Co., Santa Monica, Cal., it has been announced by Dr. George W. Lewis, chairman of the board of award. The medal was given to Mr. Douglas "for outstanding contributions to the design and construction of transport airplanes."

Mr. Douglas is an honorary fellow and past president of the Institute of the Aeronautical Sciences. He received the Collier Trophy for 1935

Registrations Soar Again; Gain a Million in 12 Months

Increase Ascribed to Augmented Life Of Vehicles on Basis of Known Data

Total U. S. motor vehicle registrations for 1939 will establish a new all time record, approximating 30,409,596 cars and trucks, according to a preliminary survey just completed for AUTOMOTIVE INDUSTRIES by Marcus Ainsworth, staff statistician. Total registrations for motor vehicles in the 48 States and the District of Columbia totaled 29,428,971 for the year 1938, making the indicated increase for the past year nearly a million units.*

Previous high tide on registrations came in 1937 which saw the registration of 29,649,270 units, after a seven-year interval of marking time from the 1930 record of 26,657,072 units.

Of the 30,409,596 vehicles registered this year, 26,106,771 are passenger cars and 4,302,825 are trucks and buses. Passenger cars show an approximate increase over last year of 3.2 per cent, while commercial vehicles gained 3.7 per cent. New York maintains first place with 2,642,994, California second with 2,597,536, Pennsylvania third with 2,067,321. The remaining States with over one million registrations are Ohio, Illinois, Texas and Michigan in the order named.

Florida shows the greatest percentage of increase with 11 per cent gain, Maryland is second with 8.2 per cent, Georgia third with 8 per cent, followed by Texas and Utah with approximately the same percentage increase 6.8 and 6.7 per cent respectively. Nebraska has about the same registrations as last year, while New Mexico and West Virginia register slight losses of 0.6 and 0.3 per cent. However, final figures, which will be published early in 1940 might wipe out these losses so that all States will show an increase.

During the past decade total registrations declined from 26,657,072 in 1930 and 23,849,932 in 1933. Other than a very slight decline during 1938 from 1937, each year has registered a material gain over the preceding year since the low of 1933. Despite the large number of cars that have been junked or taken out of service during the years

(*Turn to page* 598, *please*)

Forecast of U. S. Motor Vehicle Registrations for 1939

	PASSENGER CARS 1939	PASSENGER CARS 1938	TRUCKS AND BUSES 1939	TRUCKS AND BUSES 1938	TOTAL MOTOR VEHICLES 1939	TOTAL MOTOR VEHICLES 1938	Per cent Change
Alabama	251,796	239,178	55,458	51,243	307,254	290,421	+ 5.8
Arizona	106,000	105,447	24,350	23,344	130,350	128,791	+ 1.5
Arkansas	175,000	167,262	57,500	54,151	232,500	221,413	+ 5.2
California	2,416,155	2,339,208	181,381	170,483	2,597,536	2,509,691	+ 3.4
Colorado	310,000	303,377	31,000	32,540	341,000	335,917	+ 1.8
Connecticut	391,981	368,351	52,609	64,939	444,590	433,290	+ 2.4
Delaware	55,500	53,559	11,000	10,519	66,500	64,078	+ 4.0
District of Columbia	153,000	149,224	17,000	15,645	170,000	164,869	+ 3.2
Florida	375,000	350,222	74,000	72,229	449,000	422,451	+11.0
Georgia	382,900	357,642	87,900	78,737	470,800	436,379	+ 8.0
Idaho	110,000	109,616	30,000	27,809	140,000	137,425	+ 1.8
Illinois	1,620,000	1,567,775	228,500	222,582	1,848,500	1,790,357	+ 3.2
Indiana	815,000	793,969	125,000	123,317	940,000	917,286	+ 2.5
Iowa	656,000	650,133	91,820	92,884	747,820	743,017	+ 0.7
Kansas	476,241	476,241	113,233	97,744	589,474	573,985	+ 2.8
Kentucky	350,000	346,940	75,000	63,676	425,000	410,616	+ 3.7
Louisiana	260,400	250,671	84,500	80,167	344,900	330,838	+ 4.5
Maine	161,000	153,861	45,000	42,829	206,000	196,690	+ 4.0
Maryland	367,006	339,986	61,530	54,935	428,536	394,921	+ 8.2
Massachusetts	773,500	733,759	112,300	108,849	885,800	842,608	+ 5.0
Michigan	1,305,000	1,269,204	145,000	139,631	1,450,000	1,408,835	+ 3.0
Minnesota	719,700	705,019	117,560	116,222	837,260	821,241	+ 2.0
Mississippi	170,000	161,015	56,000	54,180	226,000	215,195	+ 5.1
Missouri	723,000	702,941	136,000	134,177	859,000	837,118	+ 2.6
Montana	134,000	130,188	43,500	41,138	177,500	171,326	+ 3.7
Nebraska	343,000	342,646	67,280	67,268	410,280	409,914	.....
Nevada	31,000	30,695	7,800	7,729	38,800	38,424	+ 1.0
New Hampshire	101,000	97,635	25,400	23,597	126,400	121,232	+ 4.4
New Jersey	885,080	862,899	138,148	137,783	1,023,226	1,000,682	+ 2.3
New Mexico	90,183	92,262	28,144	26,915	118,327	119,177	− 0.6
New York	2,282,994	2,246,608	360,000	363,635	2,642,994	2,610,243	+ 1.2
North Carolina	460,000	451,924	80,000	76,944	540,000	528,868	+ 2.0
North Dakota	141,469	141,111	33,892	33,145	175,361	174,256	+ 0.7
Ohio	1,750,000	1,655,651	190,000	177,314	1,940,000	1,832,965	+ 6.0
Oklahoma	455,028	438,874	98,034	95,147	553,062	534,021	+ 3.8
Oregon	304,573	296,837	62,859	60,484	367,432	357,321	+ 2.9
Pennsylvania	1,797,739	1,743,842	269,582	261,105	2,067,321	2,004,947	+ 3.3
Rhode Island	154,824	149,715	20,978	20,512	175,802	170,227	+ 3.3
South Carolina	242,000	237,857	43,000	41,379	285,000	279,236	+ 2.0
South Dakota	157,493	152,040	30,236	28,592	187,729	180,632	+ 4.1
Tennessee	345,000	336,900	67,100	61,724	412,100	398,624	+ 3.5
Texas	1,272,577	1,186,022	333,353	317,633	1,605,930	1,503,655	+ 6.8
Utah	127,907	120,530	25,174	23,142	153,081	143,672	+ 6.7
Vermont	79,900	78,265	9,596	9,137	89,496	87,402	+ 2.3
Virginia	378,100	366,504	66,760	67,082	444,860	433,586	+ 2.5
Washington	443,475	439,232	84,150	84,116	527,625	523,348	+ 0.9
West Virginia	216,000	215,784	43,000	44,374	259,000	260,158	− 0.3
Wisconsin	725,000	700,865	143,000	135,993	868,000	836,858	+ 3.8
Wyoming	64,250	63,176	18,200	17,589	82,450	80,765	+ 2.0
Total	26,106,771	25,272,662	4,302,825	4,156,309	30,409,596	29,428,971	+ 3.5

* Based on actual returns to date plus an estimate for the remaining period of the calendar year as furnished by the motor vehicle commissioners of the various states.

Steel Industry Reaches Peak; Sheet Deliveries Hold Up Well

Detroit District Operations Recede Slightly After Record Production Eases Consumer Tension

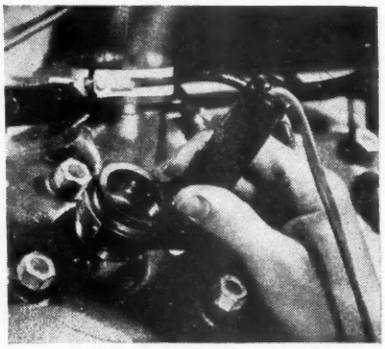
With a record-breaking ingot output of approximately 1,300,000 tons scheduled for the week ending Nov. 25, employing, according to the American Iron & Steel Institute's estimate, 93.9 per cent of the steel industry's capacity, the peak of production has likely been reached. Technical considerations, such as the need of relining some of the now active furnaces and the reconditioning of other equipment, are beginning to assume importance, and while well-filled order books assure high-rate operations during the year's five remaining weeks, tension is likely to lessen. Shipments of flat rolled steel to automobile manufacturers and part makers are being made in an orderly manner, and while a close watch is being kept so as to insure arrival of steel in time for the assemblies for which it is intended, the movement of material has been so well organized that complaints are rare. How much of the steel, which is reported to have been ordered for first-quarter delivery at a price to be determined when quotations for that period are made available, is intended for automotive consumption, is now known, but it is generally believed in the steel market that the large automobile manufacturers have arranged for much of their first-quarter requirements. The booking of good-sized orders from automotive consumers for cold finished bars is reported. In most cases, specifications accompanied orders, and much of this tonnage will be shipped next quarter. Steel mills in the Detroit area are operating at 95 per cent of capacity compared with capacity operations in the preceding week. This mild recession resulted largely from the temporary withdrawal of some furnaces for repairs, but pressure on production is reported to have also been relieved somewhat by record-breaking deliveries earlier this month. Pig-iron producers are awaiting announcement of first-quarter steel prices before committing themselves for 1940 shipments.

World stocks of tin increased 7560 tons last month, being now 46,561 tons, according to a cable received by the American Iron & Steel Institute from the Statistical Office of the International Tin Research and Development Council at The Hague, Holland. The statistical position of the metal is more reassuring to consumers than it has been at any time this year. Strict control by the British government, lest any tin fall into German hands, is becoming more and more of a market factor. Spot Straits is held at 52 cents, with futures quoted at 48 cents for March, and December at 50¼ cents.

Possibility of a reduction in the 4-cents a pound excise duty keeps the copper market in a state of agitation. It is claimed that while the President may raise this excise duty, he can not lower it, which latter is one of the possibilities under consideration in connection with the proposed Chilean trade pact. Specifications have been received by copper producers for the first 25,000-ton instalment of the 150,000-ton order recently placed here by France. The price situation is unchanged. Producers continue to quote 12½ cents for spot electrolytic, but will only supply regular customers, while in the open market 13¼ cents is being asked.

Wilkening Names Agency

The Wilkening Mfg. Co., Philadelphia, manufacturers of Pedrick piston rings, has appointed Geare-Marston, Inc. as its advertising agency.



Sees Inside Heads

E. W. Pike & Co., Elizabeth, N. J., has devised the Pike-O-Scope, an illuminated magnifier. Developed originally for examining the inside portion of a valve and valve seat, it can also be used for inspection of many other types of machinery. A set of achromatic triple lenses is lighted by a special lamp built into the bottom of a cylinder which also serves as a handle. It may be attached to any electric outlet or used with dry cell batteries. The lamp cylinder and the threaded ring for the lenses are made of a heavy, shock-resistant Bakelite molding. Defects can readily be seen at a distance of two feet from the eye. Boonton Molding Co. is the molder.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE INDUSTRIES

Moderate fluctuations around the recently attained high level of business activity have continued. *The New York Times* seasonally adjusted index advanced without interruption to 105.5 per cent of estimated normal for the week ended November 4 from 103.5 a fortnight earlier. *The Journal of Commerce* unadjusted index receded gradually in the same period from 109.3 per cent of the 1927-29 average to 107.8 and in the week ended November 11 to 107.6.

The volume of retail sales, reflecting holiday influences, reached a new seasonal peak in the week ended November 11, ranging from 10 to 17 per cent above comparable 1938 levels, according to Dun & Bradstreet estimates.

Production of electricity by the power and light industry during the same period, one per cent less than the all-time peak reached a fortnight earlier, was 13.8 per cent above the output a year ago.

The continued decline in railway freight movement during the week ended November 11 was of less than the usual seasonal proportions. The number of cars loaded was 785,961, as against the nine-year peak of 861,198 recorded three weeks earlier and 636,446 a year ago.

Bank debits to individual accounts in leading cities during the week ended November 8, one per cent above the total a fortnight ago, were 13 per cent greater than in the corresponding period last year.

Crude oil production during the week ended November 11 averaged 3,797,200 barrels daily, as compared with 3,501,350 barrels in the preceding week and 3,498,500 barrels in the week before that. Daily requirements this month, as computed by the Bureau of Mines, are 3,620,000 barrels.

Bituminous coal production in the week ended November 4 averaged 1,700,000 tons daily, as against 1,738,000 tons for the week before and 1,330,000 tons a year ago.

Cotton-mill activity increased more than seasonally in the same period. *The New York Times* index stands at 142.4 as compared with 136.3 two weeks earlier and 119.2 a year ago.

Shipments of rayon yarn during October amounted to 34,100,000 pounds, or 35.8 per cent more than in the like month last year, according to *Rayon Organon*. The total for ten months this year is 29 per cent greater than corresponding 1938 shipments.

Engineering construction contracts awarded during the week ended November 16 were 64 per cent above the total a year ago, contracts for private projects registering a tenth consecutive increase over comparable 1938 figures.

Professor Fisher's index of wholesale commodity prices for the week ended November 11 stands at 83.9 per cent of the 1926 average, as compared with the year's peak to date of 84.0, for the preceding week, and a low of 77.8 for the week ended August 20.

Excess reserves of the member banks of the Federal Reserve system dropped $180,000,000 in the week ended November 15 to an estimated total of $5,170,000,000—$360,000,000 below the peak reported three weeks ago. Business loans of the reporting members increased $38,000,000 in the fortnight ended November 8 to a total of $4,330,000,000, or $433,000,000 more than the corresponding amount last year.

Illuminating Gas "Best" Of Gasoline Substitutes

Efforts to obtain a relatively satisfactory fuel to replace gasoline for motor-vehicle operation are being carried on in Great Britain, with engineers experimenting with producer gas, manufactured from solid fuels burned in a gas producer on the vehicle; compressed illuminating gas as contained in cylinders carried on the vehicle or drawn in a trailer; and batteries in the case of electric vehicles.

Of the three, illuminating gas has proved to be the most practicable, a report made public by the Commerce Department said. Experimentation of the Birmingham Gas Department has indicated the feasibility of employing municipal gas as fuel for trucks, buses and passenger automobiles which have been adapted for this purpose.

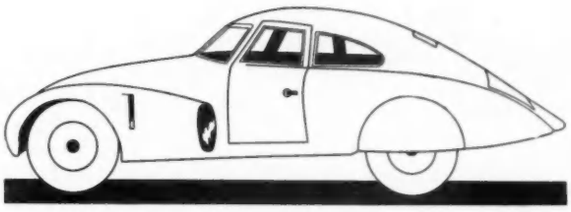
It is reported in Great Britain that ordinary gasoline and oil-driven engines can use illuminating gas with a loss of engine efficiency varying from 10 to 30 per cent. Both compression and spark ignition engines are said to be easily adaptable to the use of illuminating gas.

The chief problem in the use of compressed gas as a motor fuel has been that of storage facilities; first to obtain a tank capable of withstanding the high pressures needed; and, second, to provide a means of carrying the storage tanks on the vehicle.

Air Resistance Determinations

Some tests with the object of determining the air resistance coefficient of a modern streamlined car under different conditions of operation were conducted by Professor Dr. W. Kamm in the automotive research laboratory of Stuttgart Technical College on a 152-cu. in. Adler stock car. The coasting method was employed. It was found that the car had a forwardly projected area of 24.5 sq. ft.

With the car in the normal condition, that is, the radiator not covered, the wheels not enclosed and the sunshine roof closed, the air-resistance coefficient was found to be equal to 0.36, for use in a formula based on metric units and including the air-density factor. Converting this to English unit and assuming a standard atmosphere, we get an air-resistance coefficient of 0.00095, which is exceedingly low. It may be explained that the car is well streamlined, having a strongly sloping windshield and a long sloping tail. The most interesting results of the tests were those showing the effects on the air-resistance of various changes in the car. For instance, if the radiator was closed so that no air could flow through it, the air resistance coefficient decreased from 0.00095 to 0.00080. Opening of the sunshine roof increased the air resistance coefficient from 0.00095 to 0.00109. When the rear wheels were enclosed in cardboard to simulate rear-wheel covers, the air-resistance coefficient (with radiator open and sunshine roof closed) decreased from 0.00095 to 0.000845. Enclosing the front wheels had less effect on the air resistance, the coefficient decreasing only from 0.00095 to 0.000935. — A.T.Z. Aug. 25.



Elevation of Adler car used in German air resistance tests

Excise Tax Opposed In Manufacturers' Brief

Opposition of the automobile manufacturing industry to the special federal excise taxes on its products was reaffirmed through a presentation on the discriminatory nature of these levies, made at hearings recently concluded by treasury officials.

Testimony presented at the invitation of the government department was offered by the Automobile Manufacturers' Association not only on behalf of its members, but in support of the motor vehicle industry's customers, as the welfare of both, it was pointed out, are closely interrelated.

The automobile industry has consistently opposed the federal excise taxes, which were put in effect by Congress in 1932, as special emergency levies. The brief pointed out that this position is taken for the following specific reasons:

The taxes in question are discriminatory. While the automobile industry has always been willing to shoulder its equitable share of all necessary tax burdens, it objects to being singled out, along with a few other industries, for special levies on sales of its products. This discrimination against automobiles, parts and accessories has been intensified since the taxes were first imposed in 1932, as they have been repealed in the case of most of the other items which originally bore them.

(*Turn to page 74, please*)

U. S. Registrations

(*Continued from page 595*)

since 1933, over six and a half million more cars have been registered or an average of approximately one million gain for each year.

It is becoming increasingly evident that this continued gain in total registrations is due to longer life rather than to substantial increases in sales of new vehicles over those vehicles going out of service. This is substantiated by the survey on life of automobiles which appears in AUTOMOTIVE INDUSTRIES, for Feb. 25, 1938.

* This survey, a yearly feature, is made possible through the cooperation of the motor vehicle commissioners of the various states and is based on actual returns to date plus an estimate by the motor vehicle commissioners for the remaining weeks of the year. The total estimate is based on returns from 39 out of the 48 states and the District of Columbia.

The preliminary estimate indicates a gain over 1938 of 980,000 units or 3.5 per cent. (In this survey we endeavor to lean on the conservative side though sometimes we err in our estimate of those states from which we receive no returns. In the estimate for 1938 we were on the optimistic side to the extent of three-tenths of one per cent or, in round figures, 105,000 units. Based on this estimate 30,409,596 cars, trucks, and buses will be registered during 1939 as compared with the 29,428,971 that were registered during 1938.

GM Trial Appeal

(*Continued from page 593*)

know," the judge added.

Immediately after the trial, U. S. department of justice officials at Washington said that the split verdict would not be likely to have any effect on previous consent decrees signed by Ford and Chrysler who were indicted on similar charges at the same time the indictment was returned against General Motors.

Holmes Baldridge, chief government counsel in the South Bend case, said: "This is a step forward in the anti-trust division's policy to obtain free competition in industries by applying a workable formula as dictated by the needs of each particular industry rather than an attempt to apply a single rigid formula to all industries."

The indictments were returned May 27, 1938, and the trial got underway on October 9, this year. The government presented 68 witnesses from all parts of the nation and the defense put 152 witnesses on the stand. Each side introduced voluminous documentary evidence.

The case went to the jury early on the evening of November 15 and it was not until more than 26 hours later that the jurors reached a decision.

MEN . . . . . .

Thomas Spina, formerly with National Union Radio Corp., has been elected treasurer of the Carlton Lamp Corp., Union City, N. J.

I. C. Moreau has been named as assistant to L. S. Wood, vice-president in charge of engineering of Gar Wood Industries, Inc., Detroit.

Kenneth A. Moore, assistant traffic manager of the Automobile Manufacturers Association, Detroit, will assume on Jan. 1 the position of general traffic manager, succeeding J. S. Marvin.

H. M. Young, of St. Louis, and **J. F. Creamer**, of New York, have been elected president and vice-president, respectively, of the National Wheel & Rim Association, Inc. **F. W. Dennerline**, of Indianapolis, has been named treasurer. **Fred Prior**, of Dallas, Tex., has has been re-elected to the board of directors. Others just elected to the board are **James Henderson**, of Salt Lake City, Utah, and **W. S. Paulk**, of Jacksonville, Fla.

James L. Ashley, secretary and treasurer of the International Nickel Co. of Canada, Ltd., has retired from these positions. Mr. Ashley will continue to serve in an advisory capacity for several months and will remain as a director of the company and its various subsidiaries. **William J. Hutchinson** has been elected to succeed Mr. Ashley as treasurer. He was also elected a director to fill a vacancy on the board caused by the resignation of **William W. Mein. Henry S. Wingate**, assistant to the president of the International Nickel Co., Inc., has been elected secretary of the parent company.

Niran Bates Pope, formerly with the Automobile Manufacturers Association, and for years managing editor of *Automobile Topics*, has become associated with Korbel & Colwell, Inc., New York, in public relations work.

Edward E. O'Neill has been elected president of the American-LaFrance-Foamite Corp., Elmira, N. Y. For the same company, **William M. Cooper** has been elected to the board of directors and also vice-president and comptroller.

Wallace R. Campbell, president Ford Motor Company of Canada, Ltd., Windsor, Ont., in addition to his duties of chairman of the Canadian War Supply Board has been appointed to a new central organization to co-ordinate war purchases in Canada and the United States. This appointment has been announced by the British Government.

Paul C. Jones has been appointed president of Dominion Rubber Co., Ltd., Montreal. Mr. W. A. Eden has retired as president and has been appointed vice-chairman of the board of directors. The chairman of the board is F. B. Davis, president of the United States Rubber Co.

R. C. Berkinshaw, general manager and treasurer of the Goodyear Tire and Rubber Co., of Canada, Ltd., New Toronto, Ont., as well as director and treasurer of the Goodyear Cotton Co., Ltd., has been elected to the board of directors of the Crown Trust Co., Ltd., Montreal.

M. S. Brooks has been elevated to the presidency of the Studebaker Corp. of Canada, Ltd., Walkerville, Ont. Vice-president and general manager of the firm for the past three years, Mr. Brooks is a Canadian and entered the motor vehicle industry in 1921.

Yellow Truck & Coach Fourth Quarter Dividends

Yellow Truck & Coach Mfg. Co. has announced dividends of $1.75 per share for the fourth quarter and $7 per share on account of accumulations on its seven per cent cumulative preferred stock, payable Dec. 23, 1939, to stockholders on record Dec. 11, 1939.

New Issues Complicated Chrysler Strike

A disturbing new element was introduced into the Chrysler strike situation on Nov. 22, when a newly organized C.I.O. Foremen's Union served demands on the corporation for a meeting to begin collective bargaining. Notice stating the demands was in the form of a telegram addressed to the corporation signed by Ralph N. Branson, chairman, Dodge Truck Division United Foremen and Supervisors, Local Industrial Union No. 918, C.I.O. The union also announced that it had filed a petition with the National Labor Relations Board requesting certification for bargaining rights and charging the corporation with unfair labor practices.

This move was promptly denounced by K. T. Keller, Chrysler president, as an attempt by the U.A.W.-C.I.O. to not only control bargaining procedure from both sides of the table but also to control production. He pointed out that foremen have always been the representatives of the management, that they represented the point at which the grievance procedure between the union and the management began and that as such they had been specifically excluded from previous contracts between the corporation and the union.

R. J. Thomas, U.A.W.-C.I.O. president, replied that the Foremen's Union was a separate organization with no connection with the U.A.W.-C.I.O. and the foremen and supervisory employes were permitted to organize under the provisions of the National Labor Relations Act. He later served notice on the corporation, however, in the form of a telegram from the Foremen's Union, withdrawing its demand for bargaining with the corporation

The corporation in turn, cited numerous instances in which the U.A.W.-C.I.O. had played a part in organization of the Foremen's Union and also pointed out that both organizations are members of the same parent organization, the C.I.O. The corporation refused to accept the withdrawal telegram as bona fide unless it would receive definite assurance from the C.I.O. that the Foremen's Union issue would not reappear. It pointed out that the new union had not withdrawn its request for certification by the N.L.R.B. nor its complaint citing unfair labor practices and insisted that the move was definitely a new attempt on the part of the C.I.O. to sit on both sides of the negotiation table as well as to control production through the supervisory employes.

C.I.O. Groups Certified At 11 Chrysler Plants

The National Labor Relations Board has certified the CIO faction of the United Automobile Workers of America at 11 plants of the Chrysler Corp., Detroit. This announcement was made after the board noted the results of collective bargaining elections as follows:

Jefferson-Kercheval plants — 7209 votes for the C.I.O., 391 for the A.F. of L.; Dodge main plant — 17,654 for the C.I.O., 837 for the A.F. of L.; Dodge forge plant—1065 for the C.I.O., 33 for the A.F. of L.; Dodge truck plant—1523 for the C.I.O., 38 for the A.F. of L.; DeSoto plant, 1582 for the C.I.O., 57 for the A.F. of L.; Highland Park plant—1917 for the C.I.O., 96 for the A.F. of L.; Amplex-Harper plant—156 for the C.I.O., 3 for the A.F. of L.; Amplex-Harper plant — 156 for the C.I.O., 3 for the A.F. of L.; Plymouth plant—5585 for the C.I.O., 2771 for the A.F. of L.; Marysville plant — 519 for C.I.O., 30 for the A.F. of L.; Los Angeles plant—585 for the C.I.O., 5 for the A.F. of L.

At the New Castle, Ind. plant, the N.L.R.B. certified the International Association of Machinists, Die Sinkers Local 1222, an A.F. of L. affiliate, as the exclusive representative of the die

sinkers but grouped all production and maintenance employees within the larger unit to be represented by the C.I.O. union.

As for the bargaining agency to represent employees at the Evansville and Kokomo plants, the board indicated that its regional director at Detroit has not completed an investigation of objections raised to the elections and therefore would "not make any disposition of the case with respect to those plants until completion of such investigation."

The elections, on which the certifications were based, were held by the board in each of the 14 plants on September 27 and 28. On Oct. 29, the C.I.O. faction of the U.A.W.A. requested the N.L.R.B. to amend its order of the election so as to establish an appropriate unit consisting of the production and maintenance employees in all of the plants of the company, or in the alternative in those plants in which the C.I.O. had been designated the collective bargaining agent by a majority of the production and maintenance employees. In reply, the company and the A.F. of L's. United Automobile Workers Union contended that each plant constituted an appropriate unit.

In deciding the size of the appropriate unit, the board said that collective bargaining history in the plants had not established "a pattern of bargaining upon the basis of a single bargaining unit," pointing out that since the election results are known and since problems of wages, hours, and working conditions at each plant are similar, "we believe that all the employees in those plants where the U.A.W.A.-C.I.O obtained a majority, may properly constitute a single bargaining unit."

Strike Sets New "Record"

Having earned the questionable distinction of being the longest continuous strike in the history of the automotive industry, the latest UAW-CIO Chrysler dispute appeared to be nearing settlement just before the beginning of the Nov. 23 Thanksgiving Week, only to become deadlocked once again over the single remaining issue, hourly wage rates.

Reports from the daily conferences between representatives of the union and the corporation, presided over by federal and state conciliators, indicated that agreement had been reached on all points except the wage issue but that such agreements were tentative because dependent upon settlement of the wage question. Meanwhile a review of what had been accomplished appeared to bear out the corporation's contention that it was unnecessary for the union to strike its plants in order to secure a new contract.

Details of points already tentatively agreed upon were not being released until complete settlement of the controversy but it was reported that the union had dropped its demand for a union shop, in one form or another, a point that had been one of the original issues. The original wage demand of the union, for a general 10 cents an hour increase, also was modified to 5 cents an hour, adjustments in rate classifications and vacations with pay on the basis of 2½ to 3 per cent of each worker's annual wage. In insisting that the new wage demands were too high, Herman L. Weckler, vice president in charge of production for Chrysler, said, "practically all of our factory employes are paid by the hour. In September of this year our factory employes, both men and women, in plants throughout the United States, averaged 97.6 cents an hour. The men averaged 99 cents an hour. No salaried office employes are included in these figures.

"Our pay is more per hour than the average pay in automobile plants. It is a great deal more than the average pay of industrial workers generally in the U. S. which in July, according to the department of labor, was 64.3 cents per hour."

The union has insisted since the beginning of the dispute that it was not on strike but that workers in the corporation's plants were locked out. Picket lines have been maintained by

(*Turn to page 74, please*)

"Old Timers" Organize

At a recent meeting of the organization committee of the Automobile Old Timers held at the Hotel Lexington in New York, plans were perfected for establishing a permanent body which is to be known as The Automobile Old Timers. Dave Hennen Morris is honorary chairman, William H. Hotchkiss, vice chairman, and David Beecroft, chairman.

It was decided to create a national advisory committee with members in upward of thirty cities, and an executive committee of fifteen members from the Metropolitan area who will be available to attend meetings and plan the policies for the first year. The next annual meeting will culminate with a dinner to be held during the week of the automobile show in 1940. A committee was appointed consisting of David Beecroft, Major Augustus Post and Frederick H. Elliott, to compile the list of those available for membership on the national advisory committee and to whom invitations are now going forward.

The annual dues are five dollars. Each applicant will receive a card certifying as to the year of the holder's entry into the automobile world as a manufacturer, dealer in cars or accessories, owner, operator, contestant, or as a member of an automobile club or association. In order to qualify for membership, the applicant must establish some identification with automobiling for twenty-five years or more, up to and including 1914. With the coming of another year the same period of qualification will prevail, viz., that the applicant must have been identified with some branch of motoring for twenty-five years prior to the date of his application.

Plans for maintaining a permanent organization throughout the year are to be drafted and presented to the executive committee, upon which the following were elected to serve for the ensuing year: Dave Hennen Morris, honorary chairman; William H. Hotchkiss, vice chairman; David Beecroft, chairman; Clifford M. Bishop, Sidney B. Bowman, Harry G. Bragg, Frederick H. Elliott, Miller Reese Hutchinson, Edward P. Mauder, Arthur L. Newton, Augustus Post, Alfred Reeves, E. V. Rickenbacker, Chris Sinsabaugh and Elmer Thompson.

One of the objectives is to compile an accurate and authentic historical record of all members covering the achievements of the pioneer leaders of the automobile world, which will be available for newspapers and magazines. Many inquiries for such data have been received during recent weeks, and this work is to be undertaken immediately.

Another objective is to issue citations to those who have contributed so much to the marvelous success of the automobile up to the present time. These presentations will be made at the next annual gathering of the members. It is also planned to issue a bulletin listing the names and addresses of pioneers, news items concerning them, activities of local groups, together with the schedule of meetings that are contemplated in New York City and other cities where local chapters have been formed. Major Augustus Post was named as treasurer, and Frederick H. Elliott as secretary. Headquarters are at the Hotel Lexington, Lexington Avenue and 48th Street, New York, where members as well as those interested in the Old Timers' organization will be welcome.

Robert D. Garden

Robert D. Garden, long a colorful figure on New York's automobile row and father of famed opera singer, Mary Garden, died Nov. 20 in Aberdeen, Scotland.

For 20 years Mr. Garden was head of the Pierce-Arrow agency in New York. He retired a dozen years ago when the agency was turned over to Studebaker, and three years ago he went abroad for his health and a sight of his birthplace, which he left at 16.

Advertising Awards

(*Continued from page 9*)

series of advertisements appearing in any medium sponored by one or more trade associations, one or several related industries or geographical interests.

TECHNICAL DISTINCTION: 1. An award and two honorable mentions will be made for that advertisement or series of advertisements most distinguished by its layout, art and typography.

2. An award and two honorable mentions will be made for that advertisement or series of advertisements most distinguished by its copy.

RESEARCH ACHIEVEMENT: 1. An award and two honorable mentions will be made for a research project of independent character, not related specifically to any publication, product or service, and which has contributed to the knowledge and advancement of advertising.

2. An award and two honorable mentions will be made for a research project used in the promotion of a publication, product or service and which has contributed to the knowledge and advancement of advertising.

RADIO AWARDS: An award will be made to each of the following for contribution to the advancement of the use of radio in advertising:

1. An advertiser, agency, broadcast facility, or individual, who by contemporary service has added to the knowledge or technique of radio advertising.
2. An advertiser, agency, broadcast facility, or individual for outstanding skill in program production.
3. An advertiser, agency, broadcast facility, or individual for excellence of commercial announcements.

PUBLICATIONS

The complete line of TAG **industrial thermometers** is described in Catalog No. 1125C published by C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.*

Forty-six manufacturers of leather belting and motor bases cooperated to produce a new data book entitled "**Automatic Tension Control Short-Center Pivoted-Motor Leather Belt Drives.**"

LaSalle Steel Co., Chicago, has issued a pamphlet which described its "Stressproof No. 2" **cold finished bar steel.***

The American Chemical Paint Co., Ambler, Pa., has brought out a pamphlet which explains the nature and the use of "**Lithoform.**" The product is used to make paint stick to galvanized iron and other zinc or cadmium surfaces.*

A 1940 edition of the booklet "**Truck and Trailer Size and Weight Restrictions**" has been prepared by The Four Wheel Drive Auto Co., Clintonville, Wis.*

Jones & Laughlin Steel Corp.'s new **J & L Bessemer Flame Control cold finished screw stock** is the subject of a recently published bulletin.*

A 59-page "Quick Selector" catalog, designed to aid in the selection of the proper **electrical equipment** for a motor or lighting circuit, has been announced by the Westinghouse Electric & Mfg. Co.*

Drilling machines and jig borers manufactured by the Cleereman Machine Tool Co., Green Bay, Wis., are described in Bulletin No. 200.*

Bulletin 80-C issued by the Niagara Machine & Tool Works, Buffalo, N. Y., describes the company's latest **foot operated squaring shears and hand operated circle shears.***

Barber-Colman Co., Rockford, Ill., has prepared a leaflet covering its new **vertical hobbing machine***.

Johnson Bronze Co., New Castle, Pa., has developed a slide rule which provides easy reference to size data on its more than 800 standard stock **bronze bearings.**

A leaflet published by the Louis Allis Co., Milwaukee, Wis., describes the company's new **"Adjusto-Spede" motor** which is said to incorporate an entirely new principle in a.c. adjustable speed motors.*

A catalog has been issued by R. G. Haskins Co., Chicago, covering its type "C" **tapping machines.***

Specification data on **Bristo socket screw products** is contained in a catalog issued by the Mill Supply Division of the Bristol Co.*

Technical data, such as horsepower rating, sizes, ratios and tooling available, on **Cone-drive worm gearing** will be found in an engineering manual published by the Cone Worm Gear Division, Michigan Tool Co., Detroit.*

The new model series "T" **lathes** manufactured by the South Bend Lathe Works, South Bend, Ind., are described completely in a new catalog.

C. W. Spicer Dies

(*Continued from page* 593)

farm where he was born near Edelstein, Ill., Nov. 30, 1875. He attended Alfred University before going to Cornell.

While in college he built a horseless carriage from which stemmed his interest in mechanical power transmission. From then until his latest achievement of a few years ago—a universal joint variable speed transmission device for dynamos to illuminate and air condition railroad coaches — he was known as an outstanding authority in this field. He held numerous patents.

He, with a corps of associates, was responsible for the Class "B" Liberty truck developed during the World War for the Army.

His first manufacturing company, organized in 1905, became the Spicer Mfg. Co., Toledo, manufacturer of Brown-Lipe clutches and transmissions; Salisbury front and rear axles; Spicer universal joints, Parish frames, and other automotive equipment.

He was a trustee of Alfred University, which recently conferred upon him the degree of Doctor of Science. One of his four sons is dean of the University, another is a prominent physician in Miami, one is in the automotive manufacturing business, and the fourth is taking graduate work in the University of Chicago. He is also survived by his widow, whom he married while still in college.

His hard-edged determination to make things work as he planned led him to spend weeks at a time, until recently, traveling on railroad trains equipped with his transmission devices. He would spend all night in railroad yards inspecting this equipment and studying reports of their operation, in spite of his failing health.

One of his achievements was the organization of the society's Automotive Railroad Committee, which sponsored discussions of PRB problems of automotive engineering which has begun to become important in the railroad field.

Another keen interest of his was the standardization program of the society. He served as a hard-working member on numerous committees, and served as chairman of the Standards Committee for four years. He represented the society and automotive engineering interests on a number of inter-industry standards committees, including the American Standards Association.

Jouett Sees Fewer Errors

(*Continued from page* 593)

Discussing the industry abroad, Colonel Jouett said that as soon as France, under the Blum government, nationalized the aircraft industry, production dropped to about a dozen airplanes a month. Labor difficulties were intensified by the administration of the "Labor Front" government of that era. The British "shadow factory" plan is now, after long years of difficulties, working fairly well. About 800 aircraft a year is that country's present output rate, he believes. Germany expanded its plant facilities, but he did not hazard any guesses as to rates of production or capacity, although he discounted the quality of German manufacture.

Auburn Spark Plug Acquires New Plant

Auburn Spark Plug Co., Auburn, N. Y., has acquired the plant of the Henry Forge & Tool Co., and will be ready for operations at the new plant about Dec. 1.

For the past 30 years spark plugs have been manufactured at the present plant. The production was launched at the New York Mica and Mfg. Co. Eight years ago the change in firm name to the Auburn Spark Plug Co. was made.

The purchase of the new plant involved an outlay of $50,000. Charles J. Nolan is president of the company.

Ickes Scores Trucks

(*Continued from page* 594)

an automobile manufacturer thus to obstruct the roads that the people have built with their own money in order that they might have the pleasure of driving over them his and others' cars. This is rubbing it in with a vengeance."

Following an attack on Diesel trucks, one of which he likened to "an enormous centipede that was belching smoke and foul gases that trailed behind it for a long distance," Mr. Ickes continued: "These problems of the motor roads of America are vital, not only from the point of view of the ordinary motorist, but as they will affect such travelers from other lands as may want to see something of our country from automobiles if we can induce them to visit us. We seriously need to mend not only our road manners, but to limit the uses to which our highways may be put. Perhaps it is too late to seek to impose any effective limitation upon the right of trucks to use roads that were built for other purposes. I suspect that truck owners, like any well-organized minority, can wield more influence than millions of mere citizens who think that they ought to have a priority in the use of their own roads.

"But at least trucks might be barred from our main highways on holidays and over week ends. I especially urge that you get busy about those peregrinating pests that I saw in California. The public can stop these now while there are only a few of them. Let them spawn by the thousands, as have the trucks, and we would all find it a positive pleasure to go back to the unpaved, dusty or muddy road of thirty-five years ago."

Pyke Johnson, vice-president of the Automobile Manufacturers' Association, in speaking before the convention, emphasized the fact that the advancement of the consumers' interest is essential to the wellbeing of the motor industry. "The manufacturers' stake in the consumer welfare," he said, "is a direct and unmistakable one. Maintenance of the volume of sales and production required for continuance of mass-production economies and efficiency depends on the user's ability in future years to secure maximum utilization of the vehicles the industry produces. This means, first of all, an expanded system of highways such as is recommended in the master plan for highway development produced out of nationwide study of our present roads by the highway authorities of the Federal and State Governments."

John V. Lawrence, general manager of the American Trucking Associations, defended the position of trucks on our highways. The major portion of his speech was devoted to present the position of the trucker in regard to week-end use of the highways. He contended that consumer demand has made it necessary for shippers and farmers to distribute their products over the highways, and some of this movement must necessarily be on Saturdays and Sundays.

"Motor trucks are on the highways on Saturday afternoons, Sundays and holidays, not because their owners prefer to have them there on those days," Mr. Lawrence contended. "The contrary is true. The motor truck owner avoids as far as possible the routing of his vehicles on the roads at peak periods of traffic. In the first place, the many stops and delays encountered in routing his vehicle over congested areas increases the cost of operation, and decreases efficiency. In the second place, the labor costs increase due to the payment of overtime wages.

"Fleet operators and associations of motor truck owners," he added, "have taken voluntary steps toward the elimination of all but essential truck movements during peak periods of passenger car traffic."

Thomas P. Henry, of Detroit, was reelected by acclamation president of the association for his seventeenth term as chief of the national motoring body.

Test Laboratory Has Unique Control

(*Continued from page* 576)

type universally used for determining the anti-knock characteristics of gasolines. They are used solely for research and experimental work, actual control of plant production being maintained by other engines located elsewhere in the plant.

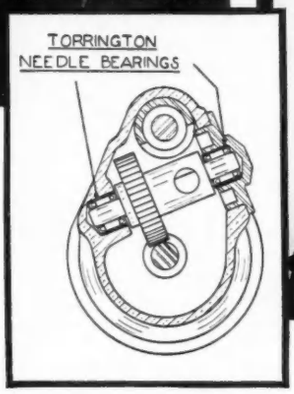
Engineers connected with petroleum refineries naturally are much interested in the octane requirements of different passenger-car models, which the refiner must meet if his product is to give satisfactory results in these cars. Tests made on cars taken off the road sometimes show much higher octane requirements than the figure given by the manufacturer, and this has been found, in some cases at least, to be due to the fact that the spark-timing governor does not advance and retard the spark in accordance with the standard engine speed spark advance curve. In one particular case a car taken off the road showed an octane requirement of 83-8, whereas the standard octane requirement of the model was only 71. The laboratory, therefore, uses a portable spark-advance indicator which shows on a dial the spark advance in degrees for any speed at which the engine may be run. A small pick-up device is mounted on the engine to give a magnetic impulse 60 deg. ahead of top dead center. This impulse is amplified by vacuum tubes and used to trip a thyraton tube, whereby a circuit is closed through an electric cell and a milliammeter. When the spark passes a moment later, another electro-magnetic impulse is produced, which also is amplified; this amplified impulse trips another thyraton tube whereby the circuit through the electric cell and milliammeter is broken. Current, therefore, flows through the milliammeter in impulses; the impulses follow one another at a sufficiently rapid rate so that the ammeter hand gives a steady indication, which is proportional to the length of time the individual impulses continue; in other words, to the difference between 60 deg. and the actual spark advance. The scale on the milliammeter gives the spark advance directly.

Preliminary tests of experimental lubricants are made on a battery of small single-cylinder test engines installed in another room known as the general laboratory room. The results of these preliminary tests determine whether the experimental lubricant gives sufficient promise to justify further tests on the more exacting multi-cylinder engines. Other equipment installed in this room includes the Almen test machine for determining the load-carrying capacity of lubricants, the Timken test machine for evaluating wear and load-carrying capacities of lubricants, and the S.A.E. extreme-pressure-lubricants test machine for evaluating the load-carrying capacities of hypoid rear-axle lubricants.

All of these rooms, together with a power room containing the power equipment necessary for the operation of the laboratory, and a car workshop where test cars are checked, repaired and equipped for the tests, are on the ground floor of the new automotive laboratory. The bunker room for chilling the air circulated to the cold rooms, occupies a large section of the second floor. Also on the second floor is a small test room where chemical or physical data on the various products may be obtained, or which can be used for photographing test specimens. The remainder of the second floor is taken up by office space and a large locker room for those who work in the laboratory.

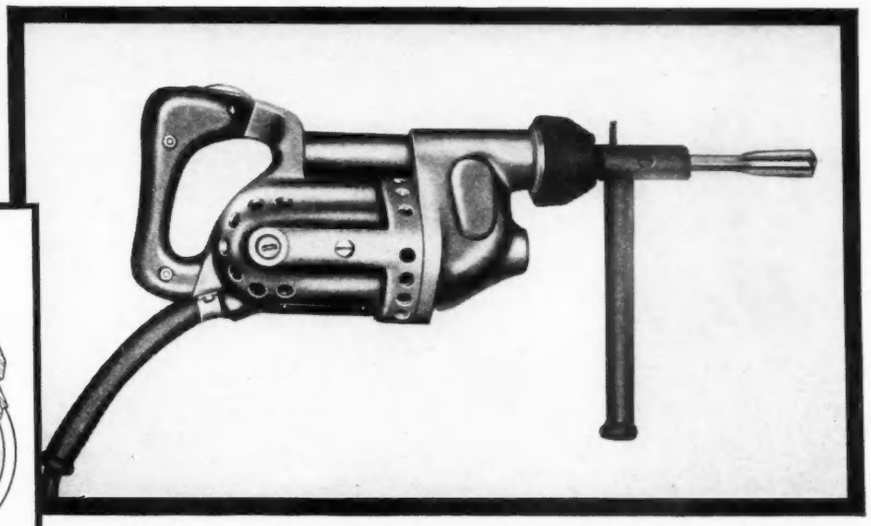
"WE GET BETTER LUBRICATION ON TOUGH JOBS WITH THE TORRINGTON NEEDLE BEARING"

SAY MAKERS OF WODACK ELECTRIC TOOLS



(*Above*) **Wodack engineers designed the Wizard Electric Hammer for ruggedness, light weight and ability to run long periods without servicing**

(*Right*) **Cross-section showing how the Needle Bearings are mounted on the trip pin spindle.**



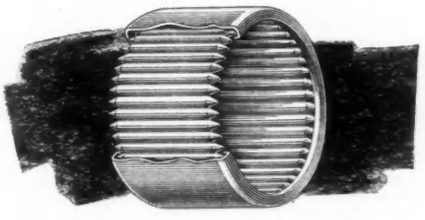
The light, high-speed Wizard Electric Hammer in which two sets of Torrington Needle Bearings transmitted 576,000,000 pounds of energy without additional lubrication—and with no signs of wear.

FOR their light-weight, hard-hitting Wizard Electric Hammer, engineers of the Wodack Electric Tool Corporation selected the Torrington Needle Bearing. In addition to small size and high unit capacity they secured a third important advantage—*better, longer lasting lubrication*. But read their own report . . .

"A stock Wizard Hammer was operated for 100 hours continuously day and night without additional lubrication on any of the working parts. Upon its disassembly, it was found that the bearings showed no signs of wear and appeared as good as new.

"The plunger strikes 2,400 times per minute, which is 144,000 times per hour. Therefore, in the 100-hour test, this part operated 14,400,000 times. At each actuation a blow of 40 pounds was struck, which totals 576,000,000 pounds of energy developed during this test period. *All of this energy passed through the two Torrington bearings, which are mounted on the trip pin spindle that operates the plunger.*

"Inasmuch as a certain amount of heat is developed during a test run of this nature, several of the parts were about to run out of lubrication. *However, the*



Torrington bearings with their unique characteristic of retaining lubricant were in very good condition." (Italics are ours).

And that is not all. The Needle Bearing is an inexpensive, easily-installed, compact unit that makes recognizable savings on assembly costs. Let the Torrington Engineering Department tell you more about this and perhaps suggest ways in which the Needle Bearing can give you exclusive advantages.

For further information write for Catalog No. 7. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, the Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings

New York Boston Philadelphia Detroit
Cleveland Chicago London, England

TORRINGTON
NEEDLE BEARING

They Pay Their Money But They Have No Choice

(*Continued from page* 562)

story is sadly different. Labor organizers, many of whom never worked in automotive plants, grasped the opportunity to collect dues that add up to staggering totals. Tacitly supported by the Wagner Law and its interpretation by the Labor Board, they created small pressure groups and went to work with sitdown strikes, slowdowns, personal intimidation and coercion as implements of their trade to force workers, who had their jobs before the agitators arrived, to join their nebulous unions, pay up or stay at home and starve.

Methods favored and adopted by the Nazis and Communists were employed. Agreements were made and broken thus providing opportunity for further demands and other agreements. Progressively, at tremendous cost to employers and employes in the plants directly concerned and to thousands of others in allied industries, as well as to those in the field of distribution, demands grew and became more arbitrary. The leaders became more powerful. The individual worker's rights, which we were told the Government could now safeguard, steadily shrivelled up.

In all of this, a Communistic drift is easily observable. And in saying so, a distinction is being made between the actions of Communists and efforts and actions that are Communistic either inherently or in the trends which they set up or augment. As one example of the activity of Communists, we have the industry's first sitdown strike which, according to reliable report, was organized and led by the man who had been the Communist candidate for the Governor of Michigan, in the election shortly preceding. Avowed Communists have acted as agitators and participators in other strikes and labor disturbances.

Among the evidence of communistic or, at least, collectivistic tendencies we have, as a recent example, the demand for labor control of production rates made in this year's Chrysler strike. That demand, coupled with the other demands which accompanied it, would, if granted, take control of a vital element of management out of the hands of the management group as we know it under the American system, and place it in the hands of a group with a gratuitously acquired communal interest in the jobs which management originally provided.

The methods developed by Syndicalists were also brought into use. They appeared in the sitdown strikes which ravaged the industry some months ago. These outrages against property rights and the civil liberties of thousands of workers were carefully planned and systematically organized. They provided forceful examples of the destructive power of small minorities strategically placed, against the rights of large majorities. Buildings were seized. Barricades were built. Weapons were fashioned and used. Property was destroyed. Rioting prevailed. Men who wanted to work were denied the right. The deepest contempt for law and authority was displayed. It was in such days of un-American doings, when the Wagner Act was a part of our substantive law, that the power of the automotive unions began to grow and the automotive worker's right to free choice received its thrust from Brutus.

[Note: In the Chart shown on page 561, the real wage potential was computed by dividing the total wages paid by the number of workers, both according to Census of Manufacturers, and adjusting the result to Cost of Living as determined by the Bureau of Labor Statistics for automotive cities.]

SOLVING THE HARD ONES

Many a design problem that used to be troublesome is being worked out these days by the use of modern materials. Take logging trailer brake drums, for example.

Holding back 50 ton loads on long, steep grades and running high temperatures is all in their day's work. But, by making his drums of Chromium-Molybdenum (0.35-0.45% Cr.; 0.35-0.45% Mo.) iron, one of the leading manufacturers has more than met the severe operating conditions.

The iron is strong and tough, with good resistance to abrasion. Furthermore, it retains these qualities after repeated heating to around 900 degrees F. followed by rapid cooling. In addition the Molybdenum content reduces the tendency to distortion due to heating — thus reducing the pounding action that leads to premature failure.

Perhaps a re-check of your own materials specifications is in order. Our technical booklet, "Molybdenum in Iron" will prove helpful. It is free on request to production executives and engineers.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

Climax Mo-lyb-den-um Company
500 Fifth Avenue · New York City

MOLY

MEN and MACHINES

(*Continued from page* 589)

stopped after the power has been shut off by a brake. Barrel type connections on the slide give an adjustment of 6 in. by electric motor. The slide is precision gibbed at all four corners with the sliding surface lined with bronze. Counterbalance cylinders are mounted in the uprights and bed, preserving the lines of the press. The press operates at 14 strokes per min., while the bed area is 80 in. front to back by 120 in. right to left. The die space, bed to slide, stroke down—adjustment up, is 60 in., with the stroke of the slide 24 in. Rated capacity of the press is 750 tons.

OTHER new or redesigned products that have been announced within the past month include the following: A low cost shaper built by the Delta Mfg. Co., Milwaukee. . . . The Guyer Gauger, a mechanical micrometer developed by the Streeter-Amet Co., Chicago, for checking the thickness of metal sheets. . . . An "industrial stethoscope" built by Electrical Research Products, Inc., New York, and intended for use by acoustic engineers engaged in the diagnosis and checking of running machinery. . . . Variable-voltage drive for reversing planers announced by the General Electric Co. . . . A.C. dynamic braking hoist control for use on electrically operated cranes and hoists—a product of the Electric Controller & Mfg. Co., Cleveland. . . . Baling press built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. . . . The Lincoln Electric Co.'s 200-amp. welder of the motor-generator D.C. arc type for welding virtually all metals and alloys and hard facing work. . . . New type of universal vise for use in connection with angular milling, grinding and drilling operations announced by the Wesson Co., Detroit. . . . New series F Hy-Lift trucks built by Baker-Raulang Co., Cleveland, in capacities of 1½ and 2 tons, the latter having a fully compensating tandem trailing axle and the former a single trailing axle. . . . A small four chaser, solid adjustable die head designed by the Geometric Tool Co., New Haven, Conn., which is made in one size only with a threading range from No. 0 to No. 10 in threads up to 100 per in. . . . New model ball bearing pillow blocks mounted in cast-iron housing—brought out by the Dodge Mfg. Corp., Mishawaka, Ind. . . . Two new 20-ton plastics molding presses added to the line of machinery built by the Standard Machinery Co. (Complete specifications obtainable from F. J. Stokes Machine Co., Philadelphia.) . . . The Ross Operating Valve Co.'s new all-air pilot controlled valve designed for semi-automatic control, full automatic control, or remote control of double acting air-cylinders . . . and, the Mercury Mfg. Co.'s new model (A-1360) "sitdown" center control fork truck which has a capacity for loads up to 2000 lb.

The American Cutter & Engineering Co., Detroit, has announced its entry in the field of manufacture of high speed metal cutting tools. The company is equipped to manufacture all types of milling cutters, reamers, counterbores and forming tools.—H. E. B., Jr.

English Develop New Aircraft Safety Device

A new air safety device to automatically cut off ignition and lighting circuits when a plane crashes or overturns has been developed in Great Britain. The device, based on pendulum action working on gravity in the case of over-turning and on inertia in the case of impact, works immediately to cut off electric and engine exhaust.

Unaffected by the plane's gyrations in the air, the mechanism may be made to work by pressing a button should fire break out in the craft.